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VOLUME II - DATA

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ANALYSIS OF FLEXIBLE
AIRCRAFT LONGITUDINAL DYNAMICS
AND HANDLING QUALITIES

VOLUME II - DATA

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TABLE OF CONTENTS

	Page
LIST OF TABLES.....	v
LIST OF FIGURES.....	vi
LIST OF SYMBOLS	ix
SUMMARY.....	xii
VOLUME I	
CHAPTER I INTRODUCTION.....	1
CHAPTER II BACKGROUND.....	3
CHAPTER III EXPERIMENTAL DATA BASE.....	10
CHAPTER IV OPEN-LOOP MODAL ANALYSIS	19
Modal Analysis	19
Vehicle Model	24
Application to Data Base Configurations	28
Numerical Results	32
CHAPTER V CLOSED-LOOP ANALYSIS	52
Neal-Smith/Bacon Methodology.....	52
Extension of Neal-Smith/Bacon Methodology.....	61
Application of the Neal-Smith/Bacon Analysis to the Data Base Configurations	68
Numerical Results	76
CHAPTER VI CONCLUSIONS	85
LIST OF REFERENCES	87

APPENDICES

Appendix A.1 Scaling Transformation for Mode Identification.....	89
Appendix A.2 n_z in Terms of Vehicle States.....	92

VOLUME II

Appendix A.3 Vehicle Configurations and Modal Analysis Results.....	96
Configuration 1	100
Configuration 2	119
Configuration 3	137
Configuration 4	155
Configuration 5	173
Configuration 6	191
Configuration 7	209
Configuration 8	227
Appendix A.4 Aeroelastic-Structural Mode Shapes	245
Appendix A.5 OCM Frequency Responses	251
Appendix A.6 Listing of Source Code for Modal Analysis Program.....	284

LIST OF TABLES

Table	Page
3.1 Summary of Data Base Configurations.....	12
3.2 Summary of Tracking Error, Pilot Rating and Pilot Comments.....	14
4.1 Summary of Navion Longitudinal Dynamics.....	23
5.1 Comparison of Resonance Peak and SP Values	67
5.2 Summary of Closed-Loop Analysis Inputs.....	75
5.3 Summary of Closed-Loop Analysis of Data Base Configurations	82

LIST OF FIGURES

Figure	Page
2.1 Pole-Zero Plot of Typical Flexible Aircraft.....	4
2.2 Pole-Zero Plot of Simple Example.....	5
3.1 Geometry of Data Base Configurations.....	11
3.2 Rigid and Elastic Pitch Angles	13
3.3 Simulation Visual Display	15
3.4 Simulation Tracking Errors	16
3.5 Simulation Pilot Ratings	17
4.1 Rigid and Elastic Pitch Angles	30
4.2 Pilot Impulse Residue Magnitudes - Config. 1.....	33
4.3 Pilot Impulse Residue Magnitudes - Config. 2.....	34
4.4 Pilot Impulse Residue Magnitudes - Config. 3.....	35
4.5 Pilot Impulse Residue Magnitudes - Config. 4.....	36
4.6 Pilot Impulse Residue Magnitudes - Config. 5.....	37
4.7 Pilot Impulse Residue Magnitudes - Config. 6.....	38
4.8 Pilot Impulse Residue Magnitudes - Config. 7.....	39
4.9 Pilot Impulse Residue Magnitudes - Config. 8.....	40

Figure	Page
4.10 Gust Impulse Residue Magnitudes - Config. 1	43
4.11 Gust Impulse Residue Magnitudes - Config. 2	44
4.12 Gust Impulse Residue Magnitudes - Config. 3	45
4.13 Gust Impulse Residue Magnitudes - Config. 4	46
4.14 Gust Impulse Residue Magnitudes - Config. 5	47
4.15 Gust Impulse Residue Magnitudes - Config. 6	48
4.16 Gust Impulse Residue Magnitudes - Config. 7	49
4.17 Gust Impulse Residue Magnitudes - Config. 8	50
5.1 Neal-Smith Model Structure	54
5.2 Frequency Response Specifications	55
5.3 Neal-Smith Criteria	57
5.4 OCM Block Diagram	59
5.5 Resonance Peak Adjustment	62
5.6 Neal-Smith/Bacon Pilot Compensation	63
5.7 Neal-Smith/Bacon Criteria	64
5.8 Pilot Rating versus Bandwidth for Neal-Smith/Bacon Configurations	65
5.9 SP versus PC for Neal-Smith Configurations	69
5.10 Dynamics of Neal-Smith Configurations	70
5.11 Dynamics of Flexible Configurations	71
5.12 Block Diagram of Tracking Analysis	74

Figure	Page
5.13 Example: OCM Frequency Response - Config. 8	77
5.14 PR versus BW for Data Base Configurations.....	81
5.15 SP versus PC for Data Base Configurations.....	83
Appendix	
Figure	
A.4.1 Mode Shape Sign Conventions.....	246
A.4.2 Aeroelastic-Structural Mode Shape - Mode 1.....	247
A.4.3 Aeroelastic-Structural Mode Shape - Mode 2.....	248
A.4.4 Aeroelastic-Structural Mode Shape - Mode 3.....	249
A.4.5 Aeroelastic-Structural Mode Shape - Mode 4.....	250
A.5.1 OCM Frequency Responses - Config. 1.....	252
A.5.2 OCM Frequency Responses - Config. 2.....	256
A.5.3 OCM Frequency Responses - Config. 3.....	260
A.5.4 OCM Frequency Responses - Config. 4.....	264
A.5.5 OCM Frequency Responses - Config. 5.....	268
A.5.6 OCM Frequency Responses - Config. 6.....	272
A.5.7 OCM Frequency Responses - Config. 7.....	276
A.5.8 OCM Frequency Responses - Config. 8.....	280

LIST OF SYMBOLS

Symbol	Meaning
$\mathbf{A}_{(\cdot)}$	plant matrices
$\mathbf{B}_{(\cdot)}$	control matrices
$\tilde{\mathbf{B}}$	modal controllability matrix
BW	bandwidth frequency
\mathbf{C}	output matrix (for states)
$\tilde{\mathbf{C}}$	modal observability matrix
$\mathbf{D}_{(\cdot)}$	disturbance matrices
$\tilde{\mathbf{D}}$	modal disturbability matrix
\mathbf{E}	output matrix (for controls)
\mathbf{F}	output matrix (for disturbances)
$\mathbf{G}_{(\cdot)}$	control matrices
$G(s)$	plant transfer functions
$H(s)$	pilot transfer function
J_p	pilot objective functional
K_p	pilot gain (feedforward)
K_x	optimal control gains
ΔK	incremental change in pilot gain K_p
OCM	Optimal Control Model of the pilot
PC	pilot compensation
\mathbf{Q}	weighting matrix for output vector
$R_{(\cdot)}$	impulse residue
SP	sensitivity parameter
\mathbf{T}	modal matrix
$\bar{\mathbf{V}}_{(\cdot)}$	intensity of white noise (\cdot)
g	weighting on pilot input rate (\dot{u}_p)
l_x	distance from c.g. to pilot station

Symbol	Meaning
n_z	plunge acceleration (g's)
$p(\cdot)$	pole of a transfer function
\mathbf{q}	modal state vector
r	weighting on pilot input (u_p)
u	perturbed forward velocity (ft/sec)
\underline{u}	input vector
v_m	motor noise
v_y	observation noise
w	Gaussian white noise
\underline{w}	disturbance vector
\underline{x}	state vector
$\hat{\underline{x}}$	state estimate vector
\underline{y}	output vector
$z(\cdot)$	zero of a transfer function
$\Phi(\cdot)$	phase of impulse residue, $R(\cdot)$
α	angle of attack, (rad)
γ	flight path angle, (rad)
$\delta(\cdot)$	control surface deflection
ϵ	attitude tracking error ($\theta - \theta_C$)
ζ	damping ratio
η	generalized deflection, (dimensionless)
$\theta(\cdot)$	attitude angle, (rad)
$\lambda(\cdot)$	eigenvalue
$\nu(\cdot)$	eigenvector
ξ	damping ratio
σ	real part of eigenvalue, λ
τ	time delay, (sec)
τ_n	neuro-motor lag, (sec)
ϕ_{ij}	mode shape, (ft)
ϕ'_{ij}	mode slope, (ft/ft)
ω	imaginary part of eigenvalue, λ

Symbol

Meaning

operations

$E\{\cdot\}$	expected value operator
$|\cdot|$ ..	magnitude of (\cdot)
$\overline{(\cdot)}$	complex conjugate of (\cdot)
$\angle (\cdot)$	phase angle of (\cdot)
$(\dot{\cdot})$	time derivative of (\cdot)

subscripts

C	commanded
R	rigid-body
T	total (rigid-body + elastic)
g.....	gust
p.....	pilot
v.....	vehicle
y.....	output or measurement

SUMMARY

As aircraft become larger and lighter due to design requirements for increased payload and improved fuel efficiency, they may also become much more flexible. For highly flexible vehicles, the handling qualities may not be accurately predicted by conventional methods. This study applies two analysis methods to a family of flexible aircraft in order to investigate how and when structural (especially dynamic aeroelastic) effects affect the dynamic characteristics of aircraft. The first type of analysis is an open-loop modal analysis technique. This method considers the effect of modal residue magnitudes on determining vehicle handling qualities. The second method is a pilot-in-the-loop analysis procedure that considers several closed-loop system characteristics. Both analyses indicated how dynamic aeroelastic effects can cause a degradation in vehicle tracking performance, based on the evaluation of some simulation results.

This report is divided into two volumes. Volume I consists of the development and application of the two analysis methods described above. Volume II consists of the presentation of the state variable models of the flexible aircraft configurations used in the analysis applications, mode shape plots for the structural modes, numerical results from the modal analysis, frequency response plots from the pilot-in-the-loop analysis and a listing of the modal analysis computer program.

Appendix A.3 Vehicle Configurations and Modal Analysis Results

The vehicle configurations are presented in state variable form using the following state and output definitions.

$$\underline{x}_v^T \triangleq [\alpha, \dot{\theta}_R, u, \theta_R, \eta_1, \eta_2, \eta_3, \eta_4, \dot{\eta}_1, \dot{\eta}_2, \dot{\eta}_3, \dot{\eta}_4], \quad (\text{A.3.1})$$

$$\underline{y}^T \triangleq [u, \theta_R, \dot{\theta}_R, \gamma, \theta_T, \dot{\theta}_T, n_z]. \quad (\text{A.3.2})$$

- where all angles are expressed in radians, all angular rates in radians per second, the forward velocity perturbation, u , has units of feet per second and the generalized elastic deflections, η , are dimensionless. The matrices which describe the vehicle configurations are defined in the following equations.

$$\dot{\underline{x}}_v = [\mathbf{A}\mathbf{V}] \underline{x}_v + [\mathbf{B}] \underline{x}_p + [\mathbf{D}] \underline{x}_g \quad (\text{A.3.3})$$

$$\underline{y} = [\mathbf{C}] \underline{x}_v + [\mathbf{E}] \underline{x}_p + [\mathbf{F}] \underline{x}_g$$

The vectors, \underline{x}_p and \underline{x}_g , are defined Chapter 4.

The results of the modal analysis consist of several parameters which are presented in matrix form. The equations which follow present the definitions of these modal analysis results.

The similarity transformation which was used to scale the eigenvectors, as described in Appendix A.1, has the following definition.

T = SCALING MATRIX

$$\begin{aligned} \Delta \text{diag} [1, 1, \frac{1}{U_0}, 1, \phi'_{11}, \phi'_{12}, \\ \phi'_{33}, \phi'_{34}, \phi'_{41}, \phi'_{42}, \phi'_{33}, \phi'_{44}] \end{aligned} \quad (\text{A.3.4})$$

The scaled system is therefore described by the following set of equations.

$$\dot{\bar{x}}_v = \mathbf{T} \mathbf{x}_v \quad (\text{A.3.5})$$

$$\begin{aligned} \dot{\bar{x}}_v &= \mathbf{T}[\mathbf{A}\mathbf{V}]\mathbf{T}^{-1} \bar{x}_v + \mathbf{T}[\mathbf{B}]\mathbf{x}_p + \mathbf{T}[\mathbf{D}]\mathbf{x}_g \\ &= [\mathbf{A}\mathbf{V}\text{-SCALED}] \bar{x}_v \\ &\quad + [\mathbf{B}\text{-SCALED}]\mathbf{x}_p + [\mathbf{D}\text{-SCALED}]\mathbf{x}_g \end{aligned} \quad (\text{A.3.6})$$

$$\begin{aligned} \mathbf{y} &= [\mathbf{C}]\mathbf{T}^{-1} \bar{x}_v + [\mathbf{E}]\mathbf{x}_p + [\mathbf{F}]\mathbf{x}_g \\ &= [\mathbf{C}\text{-SCALED}] \bar{x}_v + [\mathbf{E}]\mathbf{x}_p + [\mathbf{F}]\mathbf{x}_g \end{aligned} \quad (\text{A.3.7})$$

The pilot lag states and gust states are defined in the following equations.

$$\dot{\mathbf{x}}_p = [\mathbf{A}\mathbf{P}]\mathbf{x}_p + [\mathbf{G}_p]\eta_p \quad (\text{A.3.8})$$

$$\dot{\mathbf{x}}_g = [\mathbf{A}\mathbf{G}]\mathbf{x}_g + [\mathbf{G}_g]\eta_g \quad (\text{A.3.9})$$

The complete aircraft system state model used in the modal analysis is defined in the following equations.

$$\mathbf{x}^T \triangleq [\mathbf{x}_p^T, \mathbf{x}_g^T, \mathbf{x}_v^T] \quad (\text{A.3.10})$$

$$\begin{aligned}
\dot{\underline{x}} &= \begin{bmatrix} [\mathbf{AP}] & 0 & 0 \\ 0 & [\mathbf{AG}] & 0 \\ [\mathbf{B-SCALED}] & [\mathbf{D-SCALED}] & [\mathbf{AV-SCALED}] \end{bmatrix} \underline{x} \\
&\quad + \begin{bmatrix} \mathbf{G}_p \\ 0 \\ 0 \end{bmatrix} \eta_p + \begin{bmatrix} 0 \\ \mathbf{G}_\delta \\ 0 \end{bmatrix} \eta_\delta \\
&= [\mathbf{AA}] \underline{x} + [\mathbf{GP}] \eta_p + [\mathbf{GG}] \eta_\delta
\end{aligned} \tag{A.3.11}$$

$$\begin{aligned}
\underline{y} &= \begin{bmatrix} [\mathbf{E}] & [\mathbf{F}] & [\mathbf{C-SCALED}] \end{bmatrix} \underline{x} \\
&= [\mathbf{CC}] \underline{x}
\end{aligned} \tag{A.3.12}$$

The modal controllability, disturbability and observability matrices are defined in the following equations.

$$[\mathbf{EE}] \triangleq \text{modal matrix of } [\mathbf{AA}] \tag{A.3.13}$$

The modal controllability matrix,

$$[\mathbf{CON}] \triangleq [\mathbf{EE}]^{-1} [\mathbf{GP}]. \tag{A.3.14}$$

The modal disturbability matrix,

$$[\mathbf{DIST}] \triangleq [\mathbf{EE}]^{-1} [\mathbf{GG}]. \tag{A.3.15}$$

And, the modal observability matrix,

$$[\mathbf{OBS}] \triangleq [\mathbf{CC}] [\mathbf{EE}]. \tag{A.3.16}$$

The residues for the complete aircraft model are defined as follows. The

residues of the vehicle due to the i th control input are described by,

$$[\mathbf{C-IMPRES}]_i \triangleq \left[[\mathbf{OBS}] [\mathbf{CON}]_i \right]^T \quad (\text{A.3.17})$$

- where $[\mathbf{CON}]_i$ is the diagonal matrix formed by the i th column of the modal controllability matrix and $[\mathbf{OBS}]$ is the modal observability matrix. Each kj element of $[\mathbf{C-IMPRES}]_i$ corresponds to the residue of the k th mode for the j th output due to an impulse in the i th control input. Similarly, for the disturbance residues,

$$[\mathbf{D-IMPRES}]_i \triangleq \left[[\mathbf{OBS}] [\mathbf{DIST}]_i \right]^T \quad (\text{A.3.18})$$

Here, $[\mathbf{DIST}]_i$ is the diagonal matrix formed by the i th column of the modal disturbability matrix and so each kj element of $[\mathbf{D-IMPRES}]_i$ corresponds to the residue of the k th mode for j th output due to an impulse in the i th disturbance input.

The remainder of Appendix A.3 contains the numerical results of the modal analysis and the vehicle matrices for eight data base configurations as described above.

CONFIGURATION 1

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THE AU MATRIX (12 BY 12)

	1	2	3	4	5	6
1	-1.208E+00	9.440E-01	-6.340E-04	0.	-8.940E-03	9.525E-02
2	-7.958E+00	-2.018E+00	-2.290E-03	0.	-1.842E-01	-1.242E-01
3	-2.500E+01	0.	-2.500E-02	-3.220E+01	0.	0.
4	0.	1.000E+00	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	-7.383E+02	-1.333E+02	-1.435E-03	0.	-1.744E+02	-1.568E+01
10	1.300E+03	1.633E+01	0.	0.	1.407E+01	-5.013E+02
11	7.577E+02	5.555E+01	-3.900E-03	0.	6.990E+00	3.458E+01
12	1.688E+00	3.990E-02	0.	0.	1.623E-02	-5.701E-02
	7	8	9	10	11	12
1	4.618E-03	-4.346E-03	-2.130E-04	2.590E-03	1.526E-04	-4.998E-05
2	2.072E-01	-9.171E-02	-7.438E-03	-4.972E-02	6.963E-03	-2.004E-03
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	1.000E+00	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.	0.
7	0.	0.	0.	0.	1.000E+00	0.
8	0.	0.	0.	0.	0.	1.000E+00
9	-1.540E+01	2.088E+01	-1.139E+00	-2.770E-01	9.159E-01	-1.972E-01
10	6.593E+00	1.124E+01	2.351E-01	-8.596E+00	1.131E-01	1.120E-01
11	-4.555E+02	3.457E+00	-1.219E-01	3.784E+00	-9.485E-01	-2.535E-01
12	7.112E-03	-4.849E+02	-3.291E-04	2.427E-03	-2.754E-04	-1.000E-01

THE AG MATRIX (2 BY 2)

	1	2
1	-9.400E+00	0.
2	-2.255E-02	-9.500E+00

THE D MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	-7.371E+02
10	0.	1.298E+03
11	0.	7.564E+02
12	0.	1.697E+00

THE E VECTOR (7 BY 1)

	1
1	0.
2	0.
3	0.
4	0.
5	0.
6	0.
7	2.327E+00

THE F MATRIX (7 BY 2)

	1	2
1	0.	0.
2	0.	0.
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	9.243E+00

THE GC VECTOR (15 BY 1)

1
0.
2 1.000E+00
3 5.621E-03
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

AP = -6.667E+00

THE GP VECTOR (15 BY 1)

1
1.000E+00
2 0.
3 0.
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

THE SCALING MATRIX (12 BY 12)

	1	2	3	4	5	6
1	1.000E+00	0.	0.	0.	0.	0.
2	0.	1.000E+00	0.	0.	0.	0.
3	0.	0.	1.054E-03	0.	0.	0.
4	0.	0.	0.	1.000E+00	0.	0.
5	0.	0.	0.	-2.640E-02	0.	-3.300E-02
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.

	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	-3.456E-02	0.	0.	0.	0.	0.
7	0.	-3.636E-02	0.	0.	0.	0.
8	0.	0.	-2.640E-02	0.	0.	0.
9	0.	0.	0.	-3.300E-02	0.	0.
10	0.	0.	0.	0.	-3.456E-02	0.
11	0.	0.	0.	0.	0.	-3.636E-02
12	0.	0.	0.	0.	0.	0.

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THE AU-SCALED MATRIX (12 BY 12)

	1	2	3	4	5	6
1	-1.208E+00	9.440E-01	-6.017E-01	0.	3.380E-01	-2.886E+00
2	-7.059E+00	-2.018E+00	-2.173E+00	0.	6.977E+00	3.762E+00
3	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.	0.
4	0.	1.000E+00	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	1.949E+01	3.519E+00	3.595E-02	0.	-1.774E+02	-1.254E+01
10	-4.290E+01	-5.389E-01	0.	0.	1.759E+01	-5.061E+02
11	-2.619E+01	-1.934E+00	1.279E-01	0.	9.151E+00	3.621E+01
12	-5.138E-02	-1.451E-03	0.	0.	2.235E-02	-1.069E-01

	7	8	9	10	11	12
1	-1.336E-01	1.195E-01	8.068E-03	-7.848E-02	-4.416E-03	1.375E-04
2	-5.595E+00	2.522E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	1.300E+00	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.	0.
7	0.	0.	0.	0.	1.000E+00	0.
8	0.	0.	0.	0.	0.	1.000E+00
9	-1.176E+01	1.516E+01	-1.139E+00	-2.216E-01	6.996E-01	-1.435E-01
10	6.295E+00	1.020E+01	2.939E-01	-8.590E+00	1.080E-01	1.017E-01
11	-4.565E+02	3.286E+00	-1.595E-01	3.563E+00	-8.405E-01	-2.410E-01
12	7.482E-03	-4.649E+02	-4.531E-04	2.674E-03	-2.909E-04	-4.080E-01

THE B-SCALED VECTOR (12 BY 1)

	1
1	-2.884E-01
2	-1.503E+01
3	0.
4	0.
5	0.
6	0.
7	0.
8	0.
9	5.886E+01
10	7.103E+00
11	-2.109E+01
12	0.

 THE C-SCALED MATRIX (7 BY 12)

	1	2	3	4	5	6
1	0.	0.	9.490E+02	0.	0.	0.
2	0.	0.	0.	1.000E+00	0.	0.
3	0.	-1.000E+00	0.	0.	0.	0.
4	-1.000E+00	0.	0.	1.000E+00	0.	0.
5	0.	0.	0.	0.	1.000E+00	-1.000E+00
6	0.	1.000E+00	0.	1.000E+00	0.	0.
7	9.322E+00	-1.395E+00	1.350E+01	0.	-6.103E+01	-9.740E+01

	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	-1.000E+00	-1.000E+00	0.	0.	0.	0.
6	0.	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-8.424E+01	-4.599E+01	-6.597E-02	-3.342E+00	-7.602E-02	-3.964E-03

 THE D-SCALED MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	1.946E+01
10	0.	-4.283E+01
11	0.	-2.614E+01
12	0.	-6.170E-02

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THE AA MATRIX (15 BY 15)

	1	2	3	4	5	6	7	8
1	-6.667E+00	0.	0.	0.	0.	0.	0.	0.
2	0.	-9.400E+00	0.	0.	0.	0.	0.	0.
3	0.	-2.256E-02	-9.500E+00	0.	0.	0.	0.	0.
4	-2.884E-01	0.	-1.208E+00	9.440E-01	-6.017E-01	0.	0.	3.386E-01
5	-1.503E+01	0.	-7.049E+00	-2.059E+00	-2.173E+00	0.	0.	6.977E+00
6	0.	0.	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.	0.
7	0.	0.	0.	1.000E+00	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.
12	5.886E+01	0.	1.946E+01	1.949E+01	3.519E+00	3.595E-02	0.	-1.774E+02
13	7.103E+00	0.	-4.283E+01	-4.290E+01	-5.385E-01	0.	0.	1.759E+01
14	-2.120E+01	0.	-2.614E+01	-2.615E+01	-1.934E+00	1.279E-01	0.	9.151E+00
15	-3.921E-03	0.	-6.170E-02	-6.138E-02	-1.451E-03	0.	0.	2.235E-02
	9	10	11	12	13	14	15	
1	0.	0.	0.	0.	0.	0.	0.	
2	0.	0.	0.	0.	0.	0.	0.	
3	0.	0.	0.	0.	0.	0.	0.	
4	-2.886E+00	-1.336E-01	1.195E-01	8.068E-03	-7.848E-02	-4.418E-03	1.375E-04	
5	3.782E+00	-5.995E+00	2.522E+00	2.017E-01	-1.507E+00	-2.015E-01	5.512E-02	
6	0.	0.	0.	0.	0.	0.	0.	
7	0.	0.	0.	1.000E+00	0.	0.	0.	
8	0.	0.	0.	0.	1.000E+00	0.	0.	
9	0.	0.	0.	0.	0.	1.000E+00	0.	
10	0.	0.	0.	0.	0.	0.	1.000E+00	
11	0.	0.	0.	0.	0.	0.	0.	
12	-1.254E+01	-1.176E+01	1.516E+01	-1.139E+00	-2.216E-01	6.996E-01	-1.435E-01	
13	-5.061E+02	6.295E+00	1.020E+01	2.939E-01	-8.556E+00	1.020E-01	1.017E-01	
14	3.621E+01	-4.565E+02	3.286E+00	-1.596E-01	3.863E+00	-8.485E-01	-2.410E-01	
15	-1.029E-01	7.482E-03	-4.849E+02	-4.531E-04	2.674E-03	-2.502E-04	-4.080E-01	

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THE CC MATRIX (7 BY 15)

	1	2	3	4	5
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.
7	2.327E+00	0.	9.243E+00	9.322E+00	-1.395E+00
	6	7	8	9	10
1	9.490E+02	0.	0.	0.	0.
2	0.	1.000E+00	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	1.000E+00	0.	0.	0.
5	0.	1.000E+00	-1.000E+00	-1.000E+00	0.
6	0.	1.000E+00	0.	0.	0.
7	1.350E+01	0.	-6.103E+01	-9.740E+01	-8.424E+01
	11	12	13	14	15
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.
5	-1.000E+00	0.	0.	0.	0.
6	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-4.599E+01	-6.597E+02	-3.342E+00	-7.602E+02	-3.964E+03

SPECTRAL DECOMPOSITION OF A-AUG

	REAL PART	IMAGINARY PART	FREQUENCY (HERTZ)	DAMPING RATIO	TIME CONST. (SEC/RAD)
1	-4.47603E+00	2.20486E+01	3.58072E+00	.19894977	2.23412E-01
3	-6.55694E-01	1.33471E+01	2.12681E+00	.04906728	1.52510E+00
5	-4.75132E-01	2.12609E+01	3.38461E+00	.02210715	2.12706E+00
7	-2.03801E-01	2.29195E+01	3.50457E+00	.00925507	4.90674E+00
9	-1.31501E+00	2.43707E+00	4.40734E-01	.47485775	7.60451E-01
11	-5.78127E-04	9.69502E-02	1.18369E-02	.00660029	1.72674E+03
13	-6.06667E+00	0.	0.	1.00000000	1.50000E-01
14	-9.50000E+00	0.	0.	1.00000000	1.00000E-01
15	-1.00000E+00	0.	0.	1.00000000	1.00000E-01

[illegible]

14	(3.303E-02, 4.617E-02)	(3.303E-02, -4.617E-02)	(7.740E-04, 7.016E-05)	(7.740E-04, -7.016E-05)
15	(6.508E-05, 7.079E-05)	(6.508E-05, -7.079E-05)	(1.323E-06, 1.158E-07)	(1.328E-06, -1.158E-07)
13				
1	(3.161E-01, 0.	(0.	(0.146E-01, 0.	(0.
2	(0.	(0.106E-01, 0.	(-2.063E-01, 0.	(-2.063E-01, 0.
3	(0.	(1.007E-06, 0.	(2.741E-04, 0.	(2.741E-04, 0.
4	(-1.043E-01, 0.	(5.398E-01, 0.	(-2.203E-01, 0.	(-2.203E-01, 0.
5	(7.103E-01, 0.	(-2.035E-04, 0.	(8.559E-05, 0.	(8.559E-05, 0.
6	(-9.580E-04, 0.	(-5.682E-02, 0.	(2.344E-02, 0.	(2.344E-02, 0.
7	(-1.065E-01, 0.	(4.962E-02, 0.	(-2.020E-02, 0.	(-2.020E-02, 0.
8	(8.887E-02, 0.	(-4.189E-02, 0.	(1.694E-02, 0.	(1.694E-02, 0.
9	(1.557E-02, 0.	(-2.562E-02, 0.	(1.039E-02, 0.	(1.039E-02, 0.
10	(-8.650E-03, 0.	(-4.496E-05, 0.	(1.821E-05, 0.	(1.821E-05, 0.
11	(8.287E-06, 0.	(-4.714E-01, 0.	(1.893E-01, 0.	(1.893E-01, 0.
12	(-5.925E-01, 0.	(3.980E-01, 0.	(-1.592E-01, 0.	(-1.592E-01, 0.
13	(-1.038E-01, 0.	(2.434E-01, 0.	(-9.770E-02, 0.	(-9.770E-02, 0.
14	(5.766E-02, 0.	(4.271E-04, 0.	(-1.711E-04, 0.	(-1.711E-04, 0.
15	(-5.525E-05, 0.			

TME CON VECTOR (15 BY 1)

1 (-9.304E-03, 7.780E-02)
 2 (-9.304E-03, -7.780E-02)
 3 (-1.725E+00, 1.214E+00)
 4 (-1.725E+00, -1.214E+00)
 5 (-5.224E-01, -7.787E-02)
 6 (-5.224E-01, 7.787E-02)
 7 (-1.818E-05, -8.475E-06)
 8 (-1.818E-05, 8.475E-06)
 9 (9.815E-01, -7.601E-01)
 10 (9.815E-01, 7.601E-01)
 11 (1.096E-01, 5.935E-03)
 12 (1.096E-01, -5.935E-03)
 13 (3.164E+00, 0.)
 14 (0. , 0.)
 15 (0. , 0.)

CONTROLABILITY MATRIX (15 BY 1)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEC.))

1 (7.835E-02, 9.682E+01)
 2 (7.835E-02, -9.682E+01)
 3 (2.109E+00, 1.449E+02)
 4 (2.109E+00, -1.449E+02)
 5 (5.281E-01, -1.715E+02)
 6 (5.281E-01, 1.715E+02)
 7 (2.006E-05, -1.550E+02)
 8 (2.006E-05, 1.550E+02)
 9 (1.241E+00, -3.775E+01)
 10 (1.241E+00, 3.775E+01)
 11 (1.097E-01, 3.101E+00)
 12 (1.097E-01, -3.101E+00)
 13 (3.164E+00, 0.)
 14 (0. , 0.)
 15 (0. , 0.)

THE DIST VECTOR (15 BY 1)

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1 ( 4.942E-03, -3.728E-03 )
2 ( 4.942E-03, 3.728E-03 )
3 ( -3.764E-03, 7.477E-04 )
4 ( -3.764E-03, -7.477E-04 )
5 ( -5.511E-03, -1.547E-03 )
6 ( -5.511E-03, 1.547E-03 )
7 ( -4.359E-06, -6.243E-06 )
8 ( -4.355E-06, 6.243E-06 )
9 ( 1.542E-03, -6.891E-05 )
10 ( 1.542E-03, 6.891E-05 )
11 ( 3.274E-06, 2.545E-05 )
12 ( 3.274E-06, -2.545E-05 )
13 ( 0. , 0. )
14 ( 4.529E-01, 0. )
15 ( 1.093E+00, 0. )

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DISTURBABILITY MATRIX (15 BY 1)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

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1 ( 6.190E-03, -3.703E+01 )
2 ( 6.190E-03, 3.703E+01 )
3 ( 3.838E-03, 1.688E+02 )
4 ( 3.838E-03, -1.688E+02 )
5 ( 5.724E-03, -1.643E+02 )
6 ( 5.724E-03, 1.643E+02 )
7 ( 7.614E-06, -1.249E+02 )
8 ( 7.614E-06, 1.249E+02 )
9 ( 1.543E-03, -2.559E+00 )
10 ( 1.543E-03, 2.559E+00 )
11 ( 2.566E-05, 8.267E+01 )
12 ( 2.566E-05, -8.267E+01 )
13 ( 0. , 0. )
14 ( 4.529E-01, 0. )
15 ( 1.093E+00, 0. )

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THE OBS MATRIX (7 BY 15)

	1	2	3	4
1	(-4.665E-03, -1.191E-02)	(-4.665E-03, 1.191E-02)	(1.342E-02, 6.141E-04)	(1.342E-02, -6.141E-04)
2	(-2.662E-03, 9.688E-04)	(-2.662E-03, -9.688E-04)	(-2.344E-04, -3.123E-03)	(-2.344E-04, 3.123E-03)
3	(-9.447E-03, -6.303E-02)	(-9.447E-03, 6.303E-02)	(4.184E-02, 1.081E-03)	(4.184E-02, -1.081E-03)
4	(5.247E-03, 2.224E-04)	(5.247E-03, -2.224E-04)	(-1.203E-03, 6.319E-06)	(-1.203E-03, -6.319E-06)
5	(-8.687E-03, -2.156E-02)	(-8.687E-03, 2.156E-02)	(-3.756E-02, 7.589E-02)	(-3.756E-02, -7.589E-02)
6	(5.146E-01, -9.495E-02)	(5.146E-01, 9.495E-02)	(1.038E+00, -4.515E-01)	(1.038E+00, 4.515E-01)
7	(2.097E+00, -2.947E+00)	(2.097E+00, 2.947E+00)	(-2.179E+00, -4.790E+00)	(-2.179E+00, 4.790E+00)
	5	6	7	8
1	(2.428E-03, -9.683E-04)	(2.428E-03, 9.683E-04)	(-3.745E-04, 3.135E-04)	(-3.745E-04, -3.135E-04)
2	(-4.513E-04, -7.295E-04)	(-4.513E-04, 7.295E-04)	(2.147E-04, 1.372E-04)	(2.147E-04, -1.372E-04)
3	(1.572E-02, -9.252E-03)	(1.572E-02, 9.252E-03)	(-3.066E-03, 4.699E-03)	(-3.066E-03, -4.699E-03)
4	(-2.523E-04, 4.128E-04)	(-2.523E-04, -4.128E-04)	(2.177E-04, -1.814E-05)	(2.177E-04, 1.814E-05)
5	(4.855E-02, 8.973E-03)	(4.855E-02, -8.973E-03)	(3.043E-02, 5.705E-03)	(3.043E-02, -5.705E-03)
6	(-2.136E-01, 1.029E+00)	(-2.136E-01, -1.029E+00)	(-1.318E-01, 6.686E-01)	(-1.318E-01, -6.686E-01)
7	(4.142E+00, 1.010E+00)	(4.142E+00, -1.010E+00)	(1.070E+00, 2.966E-01)	(1.070E+00, -2.966E-01)
	9	10	11	12
1	(-6.064E+00, 2.700E+00)	(-6.064E+00, -2.700E+00)	(3.082E+01, -3.346E+02)	(3.082E+01, 3.346E+02)
2	(2.714E-02, 3.138E-01)	(2.714E-02, -3.138E-01)	(-9.179E-01, 5.534E-02)	(-9.179E-01, -5.534E-02)
3	(-8.003E-01, -3.465E-01)	(-8.003E-01, 3.465E-01)	(-4.280E-03, 7.984E-02)	(-4.280E-03, -7.984E-02)
4	(1.117E-01, -1.260E-02)	(1.117E-01, 1.260E-02)	(-5.062E-01, -9.507E-02)	(-5.062E-01, 9.507E-02)
5	(3.925E-02, 3.265E-01)	(3.925E-02, -3.265E-01)	(-9.181E-01, 6.021E-02)	(-9.181E-01, -6.021E-02)
6	(-8.494E-01, -3.342E-01)	(-8.494E-01, 3.342E-01)	(-4.704E-03, -7.966E-02)	(-4.704E-03, 7.966E-02)
7	(3.410E-01, 5.624E+00)	(3.410E-01, -5.624E+00)	(2.679E-01, -2.324E+00)	(2.679E-01, 2.324E+00)
	13	14	15	
1	(-9.092E-01, 0.)	(-1.931E-01, 0.)	(8.123E-02, 0.)	
2	(-1.065E-01, 0.)	(-5.682E-02, 0.)	(-4.344E-02, 0.)	
3	(7.103E-01, 0.)	(5.395E-01, 0.)	(-2.203E-01, 0.)	
4	(-2.238E-03, 0.)	(-5.682E-02, 0.)	(2.316E-02, 0.)	
5	(-2.023E-01, 0.)	(-3.883E-02, 0.)	(1.629E-02, 0.)	
6	(1.349E+00, 0.)	(3.694E-01, 0.)	(-1.531E-01, 0.)	
7	(-7.071E+00, 0.)	(5.659E+00, 0.)	(-2.362E+00, 0.)	

OBSERVABILITY MATRIX (7 BY 15)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

1	(1.279E-02, -1.114E+02)	(1.279E-02, 1.114E+02)	(1.344E-02, 2.619E+00)	(1.344E-02, -2.619E+00)
2	(2.833E-03, 1.600E+02)	(2.833E-03, -1.600E+02)	(3.132E-03, -9.429E+01)	(3.132E-03, 9.429E+01)
3	(6.373E-02, -9.652E+01)	(6.373E-02, 9.652E+01)	(4.185E-02, -1.481E+00)	(4.185E-02, 1.481E+00)
4	(5.252E-03, 2.427E+00)	(5.252E-03, -2.427E+00)	(1.203E-03, 1.797E+02)	(1.203E-03, -1.797E+02)
5	(2.325E-02, -1.119E+02)	(2.325E-02, 1.119E+02)	(8.468E-02, -1.163E+02)	(8.468E-02, 1.163E+02)
6	(5.223E-01, -1.045E+01)	(5.223E-01, 1.045E+01)	(1.132E+00, -2.352E+01)	(1.132E+00, 2.352E+01)
7	(3.617E+00, -5.456E+01)	(3.617E+00, 5.456E+01)	(5.262E+00, -1.145E+02)	(5.262E+00, 1.145E+02)
1	(2.614E-03, -2.174E+01)	(2.614E-03, 2.174E+01)	(4.884E-04, 1.401E+02)	(4.884E-04, -1.401E+02)
2	(8.578E-04, -1.217E+02)	(8.578E-04, 1.217E+02)	(2.548E-04, 3.259E+01)	(2.548E-04, -3.259E+01)
3	(1.624E-02, -3.048E+01)	(1.624E-02, 3.048E+01)	(5.610E-03, 1.231E+02)	(5.610E-03, -1.231E+02)
4	(4.836E-04, 1.214E+02)	(4.836E-04, -1.214E+02)	(2.185E-04, -4.763E+00)	(2.185E-04, 4.763E+00)
5	(4.541E-02, 1.046E+01)	(4.541E-02, -1.046E+01)	(3.096E-02, 1.062E+01)	(3.096E-02, -1.062E+01)
6	(1.051E+00, 1.017E+02)	(1.051E+00, -1.017E+02)	(6.817E-01, 1.012E+02)	(6.817E-01, -1.012E+02)
7	(4.264E+00, 1.370E+01)	(4.264E+00, -1.370E+01)	(1.111E+00, 1.542E+01)	(1.111E+00, -1.542E+01)
1	(6.638E+00, 1.560E+02)	(6.638E+00, -1.560E+02)	(3.360E+02, -8.474E+01)	(3.360E+02, 8.474E+01)
2	(3.149E-01, 8.506E+01)	(3.149E-01, -8.506E+01)	(9.196E-01, 1.765E+02)	(9.196E-01, -1.765E+02)
3	(8.721E-01, -1.566E+02)	(8.721E-01, 1.566E+02)	(7.996E-02, -9.307E+01)	(7.996E-02, 9.307E+01)
4	(1.125E-01, -6.431E+00)	(1.125E-01, 6.431E+00)	(9.110E-01, -1.741E+02)	(9.110E-01, 1.741E+02)
5	(3.293E-01, 8.315E+01)	(3.293E-01, -8.315E+01)	(9.201E-01, 1.762E+02)	(9.201E-01, -1.762E+02)
6	(9.119E-01, -1.585E+02)	(9.119E-01, 1.585E+02)	(8.000E-02, -9.337E+01)	(8.000E-02, 9.337E+01)
7	(5.634E+00, 8.653E+01)	(5.634E+00, -8.653E+01)	(2.339E+00, -6.342E+01)	(2.339E+00, 6.342E+01)
1	(9.092E-01, 1.800E+02)	(9.092E-01, -1.800E+02)	(8.123E-02, 0.)	(8.123E-02, 0.)
2	(1.065E-01, 1.800E+02)	(1.065E-01, -1.800E+02)	(2.344E-02, 0.)	(2.344E-02, 0.)
3	(7.103E-01, 0.)	(7.103E-01, 0.)	(2.203E-01, 1.800E+02)	(2.203E-01, -1.800E+02)
4	(2.238E-03, 1.800E+02)	(2.238E-03, -1.800E+02)	(2.316E-02, 0.)	(2.316E-02, 0.)
5	(2.023E-01, 1.800E+02)	(2.023E-01, -1.800E+02)	(1.625E-02, 0.)	(1.625E-02, 0.)
6	(1.243E+00, 0.)	(1.243E+00, 0.)	(1.531E-01, 1.800E+02)	(1.531E-01, -1.800E+02)
7	(7.071E+00, 1.800E+02)	(7.071E+00, -1.800E+02)	(2.362E+00, 1.800E+02)	(2.362E+00, -1.800E+02)

ORIGINAL PAGE IS
OF POOR QUALITY

** RESIDUE MATRICES **

*** ROWS CORRESPOND TO MODES ***
*** COLUMNS CORRESPOND TO OUTPUTS ***

IMPULSE RESIDUE MATRIX FOR CONTROL - 1

THE C-IMP RES MATRIX (15 BY 7)

1	(9.703E-04, -2.522E-04)	1	(-5.061E-05, -2.161E-04)	3	(4.991E-03, -1.486E-04)	4	(-6.612E-05, 4.062E-04)
2	(9.703E-04, 2.522E-04)	2	(-5.061E-05, 2.161E-04)	4	(4.991E-03, 1.486E-04)		(-6.612E-05, -4.062E-04)
3	(-2.390E-02, 1.524E-02)	3	(4.195E-03, 5.102E-03)	5	(-7.085E-02, 5.265E-02)		(2.067E-03, -1.471E-03)
4	(-2.390E-02, -1.524E-02)	4	(4.195E-03, -5.102E-03)	6	(-7.085E-02, -5.265E-02)		(2.067E-03, 1.471E-03)
5	(-1.344E-03, 3.167E-04)	5	(1.789E-04, 4.162E-04)	7	(-8.933E-03, 3.609E-03)		(1.640E-04, -1.960E-04)
6	(-1.344E-03, -3.167E-04)	6	(1.789E-04, -4.162E-04)	8	(-8.933E-03, -3.609E-03)		(1.640E-04, 1.960E-04)
7	(9.465E-09, -2.524E-09)	7	(-2.739E-09, -4.314E-09)	9	(9.555E-08, 5.943E-08)		(-4.112E-09, -1.516E-09)
8	(9.465E-09, 2.524E-09)	8	(-2.739E-09, 4.314E-09)	10	(-1.049E+00, 2.682E-01)		(-4.112E-09, 1.516E-09)
9	(-3.899E+00, 7.259E+00)	9	(2.651E-01, 2.873E-01)	11	(-1.049E+00, -2.682E-01)		(1.001E-01, -9.730E-02)
10	(-3.899E+00, -7.259E+00)	10	(2.651E-01, -2.873E-01)	12	(4.969E-06, -8.772E-03)		(1.001E-01, 9.730E-02)
11	(5.362E+00, 3.647E+01)	11	(-1.009E-01, 6.148E-04)	13	(-1.009E-01, -6.148E-04)		(-9.873E-02, -1.557E-02)
12	(5.362E+00, -3.647E+01)	12	(-1.009E-01, -6.148E-04)	14	(2.247E+00, 0.)		(-9.873E-02, 1.557E-02)
13	(-2.876E+00, 0.)	13	(-3.371E-01, 0.)	15	(0.)		(-7.030E-03, 0.)
14	(0.)	14	(0.)		(0.)		(0.)
15	(0.)	15	(0.)		(0.)		(0.)

1	(1.759E-03, -4.751E-04)	5	(2.599E-03, 4.092E-02)	7	(2.097E-01, 1.906E-01)
2	(1.759E-03, 4.751E-04)	6	(2.599E-03, -4.092E-02)		(2.097E-01, -1.906E-01)
3	(1.565E-01, 8.531E-02)		(-1.242E+00, 2.038E+00)		(9.572E+00, 5.617E+00)
4	(1.565E-01, -8.531E-02)		(-1.242E+00, -2.038E+00)		(9.572E+00, -5.617E+00)
5	(-2.468E-02, 8.471E-03)		(1.317E-01, -5.208E-01)		(-2.085E+00, -8.500E-01)
6	(-2.468E-02, -8.471E-03)		(1.317E-01, 5.208E-01)		(-2.085E+00, 8.500E-01)
7	(-5.047E-07, 3.616E-07)		(8.065E-06, -1.104E-05)		(-1.694E-05, -1.446E-05)
8	(-5.047E-07, -3.616E-07)		(8.065E-06, 1.104E-05)		(-1.694E-05, 1.446E-05)
9	(2.870E-01, 2.910E-01)		(-1.087E+00, 3.169E-01)		(4.609E+00, 5.260E+00)
10	(2.870E-01, -2.910E-01)		(-1.087E+00, -3.169E-01)		(4.609E+00, -5.260E+00)
11	(-1.009E-01, 1.148E-03)		(-4.134E-05, -6.777E-03)		(4.314E-02, -2.530E-01)
12	(-1.009E-01, -1.148E-03)		(-4.134E-05, 6.777E-03)		(4.314E-02, 2.530E-01)
13	(-6.402E-01, 0.)		(4.268E+00, 0.)		(-2.237E+01, 0.)
14	(0.)		(0.)		(0.)
15	(0.)		(0.)		(0.)

ORIGINAL PAGE IS
OF POOR QUALITY

CONTROL RESIDUE MATRIX (IS BY 7)
OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

	1	2	3	4
1	(1.002E-03, -1.457E+01)	(2.220E-04, -1.032E+02)	(4.994E-03, -1.705E+00)	(4.115E-04, 9.925E+01)
2	(1.002E-03, 1.457E+01)	(2.220E-04, 1.032E+02)	(4.994E-03, 1.705E+00)	(4.115E-04, -9.925E+01)
3	(2.834E-03, 1.475E+02)	(6.605E-03, 5.057E+01)	(8.827E-02, 1.434E+02)	(2.537E-03, -3.544E+01)
4	(2.834E-03, -1.475E+02)	(6.605E-03, -5.057E+01)	(8.827E-02, -1.434E+02)	(2.537E-03, 3.544E+01)
5	(1.360E-03, 1.667E+02)	(4.530E-04, 6.674E+01)	(9.634E-03, 1.580E+02)	(2.555E-04, -5.009E+01)
6	(1.360E-03, -1.667E+02)	(4.530E-04, -6.674E+01)	(9.634E-03, -1.580E+02)	(2.555E-04, 5.009E+01)
7	(9.145E-05, -1.493E+01)	(5.110E-09, -1.224E+02)	(1.25E-07, -3.189E+01)	(4.302E-09, -1.598E+02)
8	(9.145E-05, 1.493E+01)	(5.110E-09, 1.224E+02)	(1.25E-07, 3.189E+01)	(4.302E-09, 1.598E+02)
9	(8.240E+00, 1.182E+02)	(3.909E-01, 4.730E+01)	(1.005E+00, 1.657E+02)	(1.302E-01, -4.418E+01)
10	(8.240E+00, -1.182E+02)	(3.909E-01, -4.730E+01)	(1.005E+00, -1.657E+02)	(1.302E-01, 4.418E+01)
11	(3.687E+01, -8.164E+01)	(1.009E-01, 1.797E+02)	(8.772E-03, -8.997E+01)	(9.595E-02, -1.710E+02)
12	(3.687E+01, 8.164E+01)	(1.009E-01, -1.797E+02)	(8.772E-03, 8.997E+01)	(9.595E-02, 1.710E+02)
13	(2.676E+00, 1.800E+02)	(3.371E-01, 1.800E+02)	(2.247E+00, 0.)	(7.060E-03, 1.800E+02)
14	(0.)	(0.)	(0.)	(0.)
15	(0.)	(0.)	(0.)	(0.)
	5	6	7	
1	(1.822E-03, -1.511E+01)	(4.100E-02, 8.637E+01)	(2.834E-01, 4.226E+01)	
2	(1.822E-03, 1.511E+01)	(4.100E-02, -8.637E+01)	(2.834E-01, -4.226E+01)	
3	(1.766E-01, 2.853E+01)	(2.387E+00, 1.213E+02)	(1.110E-01, 2.040E+01)	
4	(1.766E-01, -2.853E+01)	(2.387E+00, -1.213E+02)	(1.110E-01, -2.040E+01)	
5	(2.610E-02, -1.611E+02)	(5.550E-01, -6.979E+01)	(2.252E+00, -1.573E+02)	
6	(2.610E-02, 1.611E+02)	(5.550E-01, 6.979E+01)	(2.252E+00, 1.573E+02)	
7	(5.209E-07, 1.444E+02)	(1.367E-05, 5.385E+01)	(2.227E-05, -1.395E+02)	
8	(5.209E-07, -1.444E+02)	(1.367E-05, -5.385E+01)	(2.227E-05, 1.395E+02)	
9	(4.068E-01, 4.539E+01)	(1.132E+00, 1.637E+02)	(6.994E+00, 4.878E+01)	
10	(4.068E-01, -4.539E+01)	(1.132E+00, -1.637E+02)	(6.994E+00, -4.878E+01)	
11	(1.009E-01, 1.793E+02)	(8.777E-03, 9.027E+01)	(2.566E-01, -8.032E+01)	
12	(1.009E-01, -1.793E+02)	(8.777E-03, -9.027E+01)	(2.566E-01, 8.032E+01)	
13	(6.402E-01, 1.600E+02)	(4.269E+00, 0.)	(2.237E+01, 1.800E+02)	
14	(0.)	(0.)	(0.)	
15	(0.)	(0.)	(0.)	

ORIGINAL PAGE IS
OF POOR QUALITY

IMPULSE RESIDUE MATRIX FOR DISTURBANCE - 1

THE D-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(-6.747E-05, -4.147E-05)	(-9.542E-06, 1.471E-05)	(-2.816E-04, -2.762E-04)	(2.676E-05, -1.846E-05)
2	(-6.747E-05, 4.147E-05)	(-9.542E-06, -1.471E-05)	(-2.816E-04, 2.762E-04)	(2.676E-05, 1.846E-05)
3	(-5.099E-05, 7.726E-06)	(3.218E-06, 1.158E-05)	(-1.567E-04, 3.535E-05)	(4.523E-06, -9.232E-07)
4	(-5.099E-05, -7.726E-06)	(3.218E-06, -1.158E-05)	(-1.567E-04, -3.535E-05)	(4.523E-06, 9.232E-07)
5	(-1.488E-05, 1.580E-06)	(1.353E-06, 4.718E-06)	(-1.010E-04, 2.662E-05)	(2.029E-06, -1.884E-06)
6	(-1.488E-05, -1.580E-06)	(1.353E-06, -4.718E-06)	(-1.010E-04, -2.662E-05)	(2.029E-06, 1.884E-06)
7	(3.590E-09, 9.718E-10)	(-7.903E-11, -1.938E-09)	(4.270E-08, -1.345E-09)	(-1.062E-09, -1.280E-09)
8	(3.590E-09, -9.718E-10)	(-7.903E-11, 1.938E-09)	(4.270E-08, 1.345E-09)	(-1.062E-09, 1.280E-09)
9	(-1.63E-03, 4.581E-03)	(6.345E-05, 4.813E-04)	(-1.258E-03, -4.750E-04)	(1.714E-04, -2.712E-05)
10	(-1.63E-03, -4.581E-03)	(6.345E-05, -4.813E-04)	(-1.258E-03, 4.750E-04)	(1.714E-04, 2.712E-05)
11	(8.615E-03, -3.113E-04)	(-4.413E-06, -2.317E-05)	(2.018E-06, -3.703E-07)	(-5.986E-07, -2.336E-05)
12	(8.615E-03, 3.113E-04)	(-4.413E-06, 2.317E-05)	(2.018E-06, 3.703E-07)	(-5.986E-07, 2.336E-05)
13	(0, 0)	(0, 0)	(0, 0)	(0, 0)
14	(-8.745E-02, 0)	(-2.573E-02, 0)	(2.445E-01, 0)	(-2.573E-02, 0)
15	(8.881E-02, 0)	(2.562E-02, 0)	(-2.409E-01, 0)	(2.532E-02, 0)
	5	6	7	
1	(-1.234E-04, -7.424E-05)	(2.189E-03, -2.388E-03)	(-6.196E-04, -2.238E-02)	
2	(-1.234E-04, 7.424E-05)	(2.189E-03, 2.388E-03)	(-6.196E-04, 2.238E-02)	
3	(1.981E-04, 2.576E-04)	(-3.569E-03, 2.475E-03)	(1.178E-02, 1.640E-02)	
4	(1.981E-04, -2.576E-04)	(-3.569E-03, -2.475E-03)	(1.178E-02, -1.640E-02)	
5	(-2.539E-04, -1.246E-04)	(2.769E-03, -5.339E-03)	(-2.127E-02, -1.197E-02)	
6	(-2.539E-04, 1.246E-04)	(2.769E-03, 5.339E-03)	(-2.127E-02, 1.197E-02)	
7	(-9.702E-08, -2.148E-07)	(4.750E-06, -2.093E-06)	(-2.814E-06, -7.914E-06)	
8	(-9.702E-08, 2.148E-07)	(4.750E-06, 2.093E-06)	(-2.814E-06, 7.914E-06)	
9	(8.310E-05, 5.013E-04)	(-1.331E-03, -4.567E-04)	(9.133E-04, 8.646E-03)	
10	(8.310E-05, -5.013E-04)	(-1.331E-03, 4.567E-04)	(9.133E-04, -8.646E-03)	
11	(-4.539E-05, -2.316E-05)	(2.017E-06, -3.811E-07)	(6.000E-05, -7.500E-07)	
12	(-4.539E-05, 2.316E-05)	(2.017E-06, 3.811E-07)	(6.000E-05, 7.500E-07)	
13	(0, 0)	(0, 0)	(0, 0)	
14	(-1.761E-02, 0)	(1.673E-01, 0)	(-2.653E+00, 0)	
15	(1.751E-02, 0)	(-1.674E-01, 0)	(2.583E+00, 0)	

ORIGINAL PAGE IS
OF POOR QUALITY

DISTURBANCE RESIDUE MATRIX (15 BY 7)
OUTPUT FORM: (MAGNITUDE , PHASE (DEG.))

1	(7.920E-05, -1.484E+02)	(1.753E-05, 1.230E+02)	(3.945E-04, -1.356E+02)	(3.251E-05, -3.460E+01)
2	(7.920E-05, 1.484E+02)	(1.753E-05, -1.230E+02)	(3.945E-04, 1.356E+02)	(3.251E-05, 3.460E+01)
3	(5.157E-05, 1.714E+02)	(1.202E-05, 7.447E+01)	(1.606E-04, 1.673E+02)	(4.616E-06, -1.154E+01)
4	(5.157E-05, -1.714E+02)	(1.202E-05, -7.447E+01)	(1.606E-04, -1.673E+02)	(4.616E-06, 1.154E+01)
5	(1.496E-05, 1.739E+02)	(4.910E-06, 7.354E+01)	(1.044E-04, 1.652E+02)	(2.769E-06, -4.288E+01)
6	(1.456E-05, -1.739E+02)	(4.910E-06, -7.354E+01)	(1.044E-04, -1.652E+02)	(2.769E-06, 4.288E+01)
7	(3.719E-08, 1.515E+01)	(1.940E-05, 9.233E+01)	(4.272E-08, 1.304E+00)	(1.664E-09, 1.297E+02)
8	(3.719E-08, -1.515E+01)	(1.940E-05, -9.233E+01)	(4.272E-08, -1.304E+00)	(1.664E-09, -1.297E+02)
9	(1.024E-02, 1.534E+02)	(4.860E-04, 8.250E+01)	(1.346E-03, -1.592E+02)	(1.735E-04, -8.990E+00)
10	(1.024E-02, -1.534E+02)	(4.860E-04, -8.250E+01)	(1.346E-03, 1.592E+02)	(1.735E-04, 8.990E+00)
11	(8.621E-03, -2.069E+00)	(2.359E-05, -1.008E+02)	(2.051E-06, -1.040E+01)	(2.337E-05, -9.147E+01)
12	(8.621E-03, 2.069E+00)	(2.359E-05, 1.008E+02)	(2.051E-06, 1.040E+01)	(2.337E-05, 9.147E+01)
13	(0.745E-02, 1.800E+02)	(2.573E-02, 1.800E+02)	(2.445E-01, 0.)	(0.573E-02, 1.800E+02)
14	(8.881E-02, 0.)	(2.562E-02, 0.)	(2.405E-01, 1.800E-02)	(2.532E-02, 0.)
15	(8.881E-02, 0.)	(2.562E-02, 0.)	(2.405E-01, 1.800E-02)	(2.532E-02, 0.)

1	(1.440E-04, -1.490E+02)	(3.239E-03, -4.748E+01)	(2.239E-02, -9.159E+01)	(2.239E-02, -9.159E+01)
2	(1.440E-04, 1.490E+02)	(3.239E-03, 4.748E+01)	(2.239E-02, 9.159E+01)	(2.239E-02, 9.159E+01)
3	(3.250E-04, 5.244E+01)	(4.342E-03, 1.452E+02)	(2.019E-02, 5.431E+01)	(2.019E-02, 5.431E+01)
4	(3.250E-04, -5.244E+01)	(4.342E-03, -1.452E+02)	(2.019E-02, -5.431E+01)	(2.019E-02, -5.431E+01)
5	(2.828E-04, 1.539E+02)	(6.015E-03, 6.259E+01)	(2.440E-02, 1.506E+02)	(2.440E-02, 1.506E+02)
6	(2.828E-04, -1.539E+02)	(6.015E-03, -6.259E+01)	(2.440E-02, -1.506E+02)	(2.440E-02, -1.506E+02)
7	(2.357E-07, 1.143E+02)	(5.190E-06, 2.378E+01)	(8.456E-06, 1.094E+02)	(8.456E-06, 1.094E+02)
8	(2.357E-07, -1.143E+02)	(5.190E-06, -2.378E+01)	(8.456E-06, -1.094E+02)	(8.456E-06, -1.094E+02)
9	(5.082E-04, 8.059E+01)	(1.407E-03, 1.611E+02)	(8.654E-03, 8.397E+01)	(8.654E-03, 8.397E+01)
10	(5.082E-04, -8.059E+01)	(1.407E-03, -1.611E+02)	(8.654E-03, -8.397E+01)	(8.654E-03, -8.397E+01)
11	(2.360E-05, -1.011E+02)	(2.052E-06, -1.070E+01)	(6.001E-05, -7.543E-01)	(6.001E-05, -7.543E-01)
12	(2.360E-05, 1.011E+02)	(2.052E-06, 1.070E+01)	(6.001E-05, 7.543E-01)	(6.001E-05, 7.543E-01)
13	(0.745E-02, 1.800E+02)	(2.573E-02, 1.800E+02)	(2.445E-01, 0.)	(0.573E-02, 1.800E+02)
14	(8.881E-02, 0.)	(2.562E-02, 0.)	(2.405E-01, 1.800E-02)	(2.532E-02, 0.)
15	(8.881E-02, 0.)	(2.562E-02, 0.)	(2.405E-01, 1.800E-02)	(2.532E-02, 0.)

CONFI GURATION 2

THE AU MATRIX (12 BY 12)

	1	2	3	4	5	6
1	-1.208E+00	9.440E-01	-6.340E-04	0.	-8.940E-03	9.525E-02
2	-7.059E+00	-2.018E+00	-2.290E-03	0.	-1.842E-01	-1.248E-01
3	-2.500E+01	0.	-2.500E-02	-3.220E+01	0.	0.
4	0.	1.000E+00	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	-7.383E+02	-1.333E+02	-1.435E-03	0.	-7.680E+01	-1.568E+01
10	1.200E+03	1.633E+01	0.	0.	1.407E+01	-5.061E+02
11	7.577E+02	5.595E+01	-3.900E-03	0.	6.990E+00	3.458E+01
12	1.666E+00	3.990E-02	0.	0.	1.623E-02	-9.700E-02

	7	8	9	10	11	12
1	4.619E-03	-4.346E-03	-2.130E-04	2.590E-03	1.526E-04	-4.998E-06
2	2.072E-01	-9.171E-02	-7.438E-03	4.972E-02	6.963E-03	-2.004E-03
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	1.000E+00	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.	0.
7	0.	0.	0.	0.	1.000E+00	0.
8	0.	0.	0.	0.	0.	1.000E+00
9	-1.540E+01	2.088E+01	-9.622E-01	-2.770E-01	9.159E-01	-1.977E-01
10	6.593E+00	1.124E+01	2.351E-01	-8.596E+00	1.131E-01	1.120E-01
11	-4.565E+02	3.457E+00	-1.219E-01	3.784E+00	-8.485E-01	-2.535E-01
12	7.112E-03	-4.849E+02	-3.290E-04	2.427E-03	-2.764E-04	-4.080E-01

THE AG MATRIX (2 BY 2)

	1	2
1	-9.400E+00	0.
2	-2.256E-02	-9.500E+00

THE D MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	-7.371E+02
10	0.	1.298E+03
11	0.	7.564E+02
12	0.	1.697E+00

THE E VECTOR (7 BY 1)

1
1
2
3
4
5
6
7

THE F MATRIX (7 BY 2)

	1	2
1	0.	0.
2	0.	0.
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	9.243E+00

THE GC VECTOR (15 BY 1)

1
0.
2 1.000E+00
3 5.621E-03
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

AP = -6.667E+00

THE GP VECTOR (15 BY 1)

1
1.000E+00
2 0.
3 0.
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

THE AU-SCALED MATRIX (12 BY 12)

	1	2	3	4	5	6
1	-1.208E+00	9.440E-01	-6.017E-01	0.	3.386E-01	-2.886E+00
2	-7.059E+00	-2.018E+00	-2.173E+00	0.	6.977E+00	3.782E+00
3	-2.63E-02	0.	-2.500E-02	-3.39E-02	0.	0.
4	0.	1.000E+00	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	1.949E-01	3.519E+00	3.595E-02	0.	-7.680E+01	-1.254E+01
10	-4.230E+01	-5.389E-01	0.	0.	1.759E+01	-5.051E+02
11	-2.619E+01	-1.934E+00	1.279E-01	0.	9.151E+00	3.621E+01
12	-6.138E-02	-1.451E-03	0.	0.	2.235E-02	-1.059E-01

	7	8	9	10	11	12
1	-1.336E-01	1.195E-01	8.062E-03	-7.848E-02	-4.416E-03	1.375E-04
2	-5.995E+00	2.522E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	1.000E+00	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.	0.
7	0.	0.	0.	0.	1.000E+00	0.
8	0.	0.	0.	0.	0.	1.000E+00
9	-1.176E+01	1.516E+01	-9.622E-01	-2.216E-01	6.936E-01	-1.435E-01
10	6.295E+00	1.020E+01	2.539E-01	-8.596E+00	1.080E-01	1.017E-01
11	-4.565E+02	3.286E+00	-1.596E-01	3.963E+00	-8.485E-01	-2.410E-01
12	7.482E-03	-4.849E+02	-4.531E-04	2.674E-03	-2.908E-04	-4.080E-01

THE B-SCALED VECTOR (12 BY 1)

	1
1	-2.884E-01
2	-1.503E+01
3	0.
4	0.
5	0.
6	0.
7	0.
8	0.
9	5.886E+01
10	7.103E+00

THE C-SCALED MATRIX (7 BY 12)

	1	2	3	4	5	6
1	0.	0.	9.490E+02	0.	0.	0.
2	0.	0.	0.	1.000E+00	0.	0.
3	0.	1.000E+00	0.	0.	0.	0.
4	-1.000E+00	0.	0.	1.000E+00	0.	0.
5	0.	0.	0.	1.000E+00	-1.000E+00	-1.000E+00
6	0.	1.000E+00	0.	0.	0.	0.
7	9.322E+00	-1.395E+00	1.350E+01	0.	-1.969E+01	-9.740E+01

	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	-1.000E+00	-1.000E+00	0.	0.	0.	0.
6	0.	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-8.424E+01	-4.599E+01	6.684E-03	-3.342E+00	-7.602E-02	-3.964E-03

THE D-SCALED MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	1.946E+01
10	0.	-4.283E+01
11	0.	-2.611E+01
12	0.	-6.170E-02

THE CC MATRIX (7 BY 15)

	1	2	3	4	5
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	1.000E+00	0.
4	0.	0.	-1.000E+00	0.	0.
5	0.	0.	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.
7	2.327E+00	0.	9.243E+00	9.322E+00	-1.395E+00
	6	7	8	9	10
1	9.490E+02	0.	0.	0.	0.
2	0.	1.000E+00	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	1.000E+00	0.	0.	0.
5	0.	1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
6	0.	0.	0.	0.	0.
7	1.350E+01	0.	-1.969E+01	-9.740E+01	-8.424E+01
	11	12	13	14	15
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.
5	-1.000E+00	0.	0.	0.	0.
6	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-4.599E+01	6.684E-03	-3.342E+00	-7.602E-02	-3.964E-03

SPECTRAL DECOMPOSITION OF A-AUG

	REAL PART	IMAGINARY PART	FREQUENCY (HERTZ)	DAMPING RATIO	TIME CONST. (SEC/RAD)
1	-4.47741E+00	2.20532E+01	3.58149E+00	.19896825	2.23343E-01
3	-4.63559E-01	2.12668E+01	3.38552E+00	.02179211	2.15722E+00
5	-2.03802E-01	2.20195E+01	3.50467E+00	.00925509	4.90673E+00
7	-7.17925E-01	8.82912E+00	1.40984E+00	.06104592	1.39290E+00
9	-1.17125E+00	2.22513E+00	4.01614E-01	.46415110	8.53792E-01
11	1.09577E-03	7.73185E-02	1.23069E-02	-.01417072	-9.12600E+02
13	-6.65657E+00	0.	0.	1.00000000	1.50000E-01
14	-9.50000E+00	0.	0.	1.00000000	1.05263E-01
15	-9.40000E+00	0.	0.	1.00000000	1.06383E-01

14 (	1.404E-02, -4.871E-02)	(	1.404E-02, 4.871E-02)	(	3.112E-04, 7.746E-04)	(	3.112E-04, -7.746E-04)
15 (	1.411E-05, -8.456E-05)	(	1.411E-05, 8.456E-05)	(	5.349E-07, 1.320E-06)	(	5.349E-07, -1.320E-06)
13							
1 (	2.372E-01, 0.	) (	0.	) (	0.	) (	0.
2 (	0.	) (	0.	) (	8.904E-01, 0.	) (	0.
3 (	0.	) (	4.417E-01, 0.	) (	-2.009E-01, 0.	) (	0.
4 (	-7.126E-02, 0.	) (	1.123E-03, 0.	) (	-2.722E-04, 0.	) (	0.
5 (	4.786E-01, 0.	) (	4.514E-01, 0.	) (	-2.071E-01, 0.	) (	0.
6 (	-6.494E-04, 0.	) (	-1.670E-04, 0.	) (	7.898E-05, 0.	) (	0.
7 (	-7.179E-02, 0.	) (	-4.752E-02, 0.	) (	2.203E-02, 0.	) (	0.
8 (	1.237E-01, 0.	) (	6.950E-02, 0.	) (	-3.198E-02, 0.	) (	0.
9 (	1.295E-02, 0.	) (	-3.555E-02, 0.	) (	1.617E-02, 0.	) (	0.
10 (	-5.450E-03, 0.	) (	-2.164E-02, 0.	) (	9.874E-03, 0.	) (	0.
11 (	8.016E-06, 0.	) (	-3.789E-05, 0.	) (	1.726E-05, 0.	) (	0.
12 (	-8.247E-01, 0.	) (	-6.603E-01, 0.	) (	3.006E-01, 0.	) (	0.
13 (	-8.633E-02, 0.	) (	3.377E-01, 0.	) (	-1.520E-01, 0.	) (	0.
14 (	3.634E-02, 0.	) (	2.056E-01, 0.	) (	-9.282E-02, 0.	) (	0.
15 (	-5.344E-05, 0.	) (	3.600E-04, 0.	) (	-1.622E-04, 0.	) (	0.
14							
1 (	0.	) (	0.	) (	0.	) (	0.
2 (	0.	) (	4.417E-01, 0.	) (	-2.009E-01, 0.	) (	0.
3 (	0.	) (	1.123E-03, 0.	) (	-2.722E-04, 0.	) (	0.
4 (	-7.126E-02, 0.	) (	4.514E-01, 0.	) (	-2.071E-01, 0.	) (	0.
5 (	4.786E-01, 0.	) (	-1.670E-04, 0.	) (	7.898E-05, 0.	) (	0.
6 (	-6.494E-04, 0.	) (	-4.752E-02, 0.	) (	2.203E-02, 0.	) (	0.
7 (	-7.179E-02, 0.	) (	6.950E-02, 0.	) (	-3.198E-02, 0.	) (	0.
8 (	1.237E-01, 0.	) (	-3.555E-02, 0.	) (	1.617E-02, 0.	) (	0.
9 (	1.295E-02, 0.	) (	-2.164E-02, 0.	) (	9.874E-03, 0.	) (	0.
10 (	-5.450E-03, 0.	) (	-3.789E-05, 0.	) (	1.726E-05, 0.	) (	0.
11 (	8.016E-06, 0.	) (	-6.603E-01, 0.	) (	3.006E-01, 0.	) (	0.
12 (	-8.247E-01, 0.	) (	3.377E-01, 0.	) (	-1.520E-01, 0.	) (	0.
13 (	-8.633E-02, 0.	) (	2.056E-01, 0.	) (	-9.282E-02, 0.	) (	0.
14 (	3.634E-02, 0.	) (	3.600E-04, 0.	) (	-1.622E-04, 0.	) (	0.
15 (	-5.344E-05, 0.	) (	3.600E-04, 0.	) (	-1.622E-04, 0.	) (	0.

THE CON VECTOR (15 BY 1)

```

1 ( 9.681E-02, 1.501E-02 )
2 ( 9.681E-02, -1.501E-02 )
3 (-3.734E-01, 3.362E-01 )
4 (-3.734E-01, -3.362E-01 )
5 ( 2.081E-06, -7.658E-06 )
6 ( 2.081E-06, 7.658E-06 )
7 ( 2.922E+00, 4.880E-01 )
8 ( 2.922E+00, -4.880E-01 )
9 ( 7.499E-02, 9.574E-01 )
10 ( 7.499E-02, -9.574E-01 )
11 ( 4.762E-02, 9.076E-02 )
12 ( 4.762E-02, -9.076E-02 )
13 ( 4.215E+00, 0. )
14 ( 0. , 0. )
15 ( 0. , 0. )

```

CONTROLABILITY MATRIX (15 BY 1)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1 ( 9.797E-02, 8.812E+00 )
2 ( 9.797E-02, -8.812E+00 )
3 ( 5.024E-01, 1.380E+02 )
4 ( 5.024E-01, -1.380E+02 )
5 ( 7.936E-06, -7.420E+01 )
6 ( 7.936E-06, 7.420E+01 )
7 ( 2.962E+00, 9.481E+00 )
8 ( 2.962E+00, -9.481E+00 )
9 ( 9.604E-01, 8.552E+01 )
10 ( 9.604E-01, -8.552E+01 )
11 ( 1.025E-01, -6.231E+01 )
12 ( 1.025E-01, 6.231E+01 )
13 ( 4.215E+00, 0. )
14 ( 0. , 0. )
15 ( 0. , 0. )

```

THE DIST VECTOR (15 BY 1)

```

1 (-3.570E-03, -4.992E-03)
2 (-3.570E-03, 4.992E-03)
3 (-4.636E-03, 3.237E-03)
4 (-4.636E-03, -3.237E-03)
5 ( 7.567E-06, -9.47E-07)
6 ( 7.567E-06, 9.47E-07)
7 ( 3.305E-03, 2.978E-03)
8 ( 3.305E-03, -2.978E-03)
9 (-6.785E-04, 1.117E-03)
10 (-6.785E-04, -1.117E-03)
11 ( 2.215E-05, 6.871E-06)
12 ( 2.215E-05, -6.871E-06)
13 ( 0, 0 )
14 ( 5.235E-01, 0 )
15 ( 1.123E+00, 0 )

```

DISTURBABILITY MATRIX (15 BY 1)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1 ( 6.137E-03, -1.256E+02)
2 ( 6.137E-03, 1.256E+02)
3 ( 5.654E-03, 1.451E+02)
4 ( 5.654E-03, -1.451E+02)
5 ( 7.625E-06, -7.094E+00)
6 ( 7.625E-06, 7.094E+00)
7 ( 4.450E-03, 4.201E+01)
8 ( 4.450E-03, -4.201E+01)
9 ( 1.307E-03, 1.213E+02)
10 ( 1.307E-03, -1.213E+02)
11 ( 2.320E-05, 1.723E+01)
12 ( 2.320E-05, -1.723E+01)
13 ( 0, 0 )
14 ( 5.235E-01, 0 )
15 ( 1.123E+00, 0 )

```


THE OBS MATRIX (7 BY 15)

1	(1.180E-02, -4.968E-03)	(1.180E-02, 4.968E-03)	(2.311E-03, 1.263E-03)	(2.311E-03, -1.263E-03)	4
2	(-1.039E-03, -2.637E-03)	(-1.039E-03, 2.637E-03)	(2.719E-04, -8.226E-04)	(2.719E-04, 8.226E-04)	
3	(6.280E-02, -1.112E-02)	(6.280E-02, 1.112E-02)	(1.737E-02, 6.164E-03)	(1.737E-02, -6.164E-03)	
4	(-9.715E-05, 5.259E-03)	(-9.715E-05, -5.259E-03)	(-4.930E-04, 6.177E-05)	(-4.930E-04, -6.177E-05)	
5	(2.096E-02, -8.955E-03)	(2.096E-02, 8.955E-03)	(2.230E-02, 4.304E-02)	(2.230E-02, -4.304E-02)	
6	(1.037E-01, 5.023E-01)	(1.037E-01, -5.023E-01)	(-9.259E-01, 4.571E-01)	(-9.259E-01, -4.571E-01)	
7	(2.905E+00, 2.049E+00)	(2.905E+00, -2.049E+00)	(1.677E+00, 3.793E+00)	(1.677E+00, -3.793E+00)	
1	(4.795E-04, 2.031E-04)	(4.795E-04, -2.031E-04)	(-5.627E-02, 4.397E-02)	(-5.627E-02, -4.397E-02)	8
2	(2.327E-05, -2.673E-04)	(2.327E-05, 2.673E-04)	(7.387E-03, 8.169E-03)	(7.387E-03, -8.169E-03)	
3	(5.692E-03, 5.668E-04)	(5.692E-03, -5.668E-04)	(-7.743E-02, 5.936E-02)	(-7.743E-02, -5.936E-02)	
4	(-1.291E-04, -1.908E-04)	(-1.291E-04, 1.908E-04)	(2.932E-03, -2.400E-03)	(2.932E-03, 2.400E-03)	
5	(-9.555E-03, -2.569E-02)	(-9.555E-03, 2.569E-02)	(1.131E-01, 6.614E-02)	(1.131E-01, -6.614E-02)	
6	(6.557E-01, -2.044E-01)	(6.557E-01, 2.044E-01)	(-6.651E-01, 9.512E-01)	(-6.651E-01, -9.512E-01)	
7	(-3.166E-01, -1.151E+00)	(-3.166E-01, 1.151E+00)	(2.650E+00, 1.708E+00)	(2.650E+00, -1.708E+00)	
1	(6.458E+00, 3.861E+00)	(6.458E+00, -3.861E+00)	(3.445E+02, -1.290E+02)	(3.445E+02, 1.290E+02)	12
2	(2.433E-01, -2.164E-01)	(2.433E-01, 2.164E-01)	(-4.527E-01, -7.758E-01)	(-4.527E-01, 7.758E-01)	
3	(1.976E-01, 7.996E-01)	(1.976E-01, -7.996E-01)	(5.948E-02, -3.585E-02)	(5.948E-02, 3.585E-02)	
4	(-8.409E-02, -9.132E-02)	(-8.409E-02, 9.132E-02)	(-2.772E-01, -8.443E-01)	(-2.772E-01, 8.443E-01)	
5	(1.832E-01, -2.385E-01)	(1.832E-01, 2.385E-01)	(-4.308E-01, -7.838E-01)	(-4.308E-01, 7.838E-01)	
6	(3.166E-01, 6.888E-01)	(3.166E-01, -6.888E-01)	(6.012E-02, -3.417E-02)	(6.012E-02, 3.417E-02)	
7	(4.877E+00, -3.554E+00)	(4.877E+00, 3.554E+00)	(1.572E+00, -6.505E-01)	(1.572E+00, 6.505E-01)	
1	(-6.163E-01, 0.)	(-1.505E-01, 0.)	(7.495E-02, 0.)	(7.495E-02, 0.)	15
2	(-7.175E-02, 0.)	(-4.752E-02, 0.)	(2.203E-02, 0.)	(2.203E-02, 0.)	
3	(4.786E-01, 0.)	(4.514E-01, 0.)	(-2.071E-01, 0.)	(-2.071E-01, 0.)	
4	(-5.315E-04, 0.)	(-4.964E-02, 0.)	(2.231E-02, 0.)	(2.231E-02, 0.)	
5	(-2.030E-01, 0.)	(-5.979E-02, 0.)	(2.796E-02, 0.)	(2.796E-02, 0.)	
6	(1.352E+00, 0.)	(5.680E-01, 0.)	(-2.628E-01, 0.)	(-2.628E-01, 0.)	
7	(-3.746E+00, 0.)	(6.232E+00, 0.)	(-2.830E+00, 0.)	(-2.830E+00, 0.)	

OBSERVABILITY MATRIX (7 BY 15)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1 ( 1.280E-02, -2.284E+01 ) ( 1.280E-02, 2.294E+01 ) ( 2.634E-03, 2.866E+01 ) ( 2.634E-03, -2.866E+01 )
2 ( 2.834E-03, -1.115E+02 ) ( 2.834E-03, 1.115E+02 ) ( 8.663E-04, -7.171E+01 ) ( 8.663E-04, 7.171E+01 )
3 ( 6.375E-02, -1.004E+01 ) ( 6.378E-02, 1.004E+01 ) ( 1.843E-02, 1.954E+01 ) ( 1.843E-02, -1.954E+01 )
4 ( 5.260E-03, 9.145E+01 ) ( 5.260E-03, -9.106E+01 ) ( 4.569E-04, 1.729E+02 ) ( 4.569E-04, -1.729E+02 )
5 ( 2.279E-02, -2.314E+01 ) ( 2.279E-02, 2.314E+01 ) ( 4.875E-02, 6.198E+01 ) ( 4.875E-02, -6.198E+01 )
6 ( 5.125E-01, 7.834E+01 ) ( 5.129E-01, -7.834E+01 ) ( 1.031E+00, -1.532E+02 ) ( 1.031E+00, 1.532E+02 )
7 ( 3.555E+00, 3.519E+01 ) ( 3.555E+00, -3.519E+01 ) ( 4.147E+00, 6.615E+01 ) ( 4.147E+00, -6.615E+01 )

1 ( 5.207E-04, 2.296E+01 ) ( 5.207E-04, -2.296E+01 ) ( 7.141E-02, 1.420E+02 ) ( 7.141E-02, -1.420E+02 )
2 ( 2.684E-04, -8.503E+01 ) ( 2.684E-04, 8.503E+01 ) ( 1.101E-02, 4.788E+01 ) ( 1.101E-02, -4.788E+01 )
3 ( 5.909E-03, 5.504E+00 ) ( 5.909E-03, -5.504E+00 ) ( 9.757E-02, 1.425E+02 ) ( 9.757E-02, -1.425E+02 )
4 ( 2.304E-04, -1.241E+02 ) ( 2.304E-04, 1.241E+02 ) ( 3.790E-03, -3.930E+01 ) ( 3.790E-03, 3.930E+01 )
5 ( 3.119E-02, -1.078E+02 ) ( 3.119E-02, 1.078E+02 ) ( 1.310E-01, -3.031E+01 ) ( 1.310E-01, 3.031E+01 )
6 ( 6.862E-01, -1.731E+01 ) ( 6.862E-01, 1.731E+01 ) ( 1.161E+00, 1.250E+02 ) ( 1.161E+00, -1.250E+02 )
7 ( 1.194E+00, -1.054E+02 ) ( 1.194E+00, 1.054E+02 ) ( 3.153E+00, 3.280E+01 ) ( 3.153E+00, -3.280E+01 )

1 ( 7.558E+00, 3.072E+01 ) ( 7.558E+00, -3.072E+01 ) ( 3.678E+02, -2.054E+01 ) ( 3.678E+02, 2.054E+01 )
2 ( 3.264E-01, -4.154E+01 ) ( 3.264E-01, 4.154E+01 ) ( 8.982E-01, -1.203E+02 ) ( 8.982E-01, 1.203E+02 )
3 ( 8.237E-01, 7.612E+01 ) ( 8.237E-01, -7.612E+01 ) ( 6.945E-02, -3.108E+01 ) ( 6.945E-02, 3.108E+01 )
4 ( 1.241E-01, -1.326E+02 ) ( 1.241E-01, 1.326E+02 ) ( 8.887E-01, -1.082E+02 ) ( 8.887E-01, 1.082E+02 )
5 ( 3.008E-01, -5.248E+01 ) ( 3.008E-01, 5.248E+01 ) ( 8.944E-01, -1.188E+02 ) ( 8.944E-01, 1.188E+02 )
6 ( 7.590E-01, 6.518E+01 ) ( 7.590E-01, -6.518E+01 ) ( 6.916E-02, -2.961E+01 ) ( 6.916E-02, 2.961E+01 )
7 ( 6.034E+00, -3.608E+01 ) ( 6.034E+00, 3.608E+01 ) ( 2.030E+00, -1.869E+01 ) ( 2.030E+00, 1.869E+01 )

1 ( 5.163E-01, 1.800E+02 ) ( 5.163E-01, -1.800E+02 ) ( 7.495E-02, 0. ) ( 7.495E-02, -0. )
2 ( 7.179E-02, 1.800E+02 ) ( 7.179E-02, -1.800E+02 ) ( 2.203E-02, 0. ) ( 2.203E-02, -0. )
3 ( 4.786E-01, 0. ) ( 4.786E-01, -0. ) ( 2.071E-01, 1.800E+02 ) ( 2.071E-01, -1.800E+02 )
4 ( 5.315E-04, 1.800E+02 ) ( 5.315E-04, -1.800E+02 ) ( 2.231E-02, 0. ) ( 2.231E-02, -0. )
5 ( 2.030E-01, 1.800E+02 ) ( 2.030E-01, -1.800E+02 ) ( 2.796E-02, 0. ) ( 2.796E-02, -0. )
6 ( 1.353E+00, 0. ) ( 1.353E+00, -0. ) ( 2.628E-01, 1.800E+02 ) ( 2.628E-01, -1.800E+02 )
7 ( 2.745E+00, 1.800E+02 ) ( 2.745E+00, -1.800E+02 ) ( 2.830E+00, 1.800E+02 ) ( 2.830E+00, -1.800E+02 )

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** RESIDUE MATRICES **
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*** POWS CORRESPOND TO MODES ***
*** COLUMNS CORRESPOND TO OUTPUTS ***
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IMPULSE RESIDUE MATRIX FOR CONTROL - 1

ORIGINAL PAGE IS
OF POOR QUALITY

THE C-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(1.217E-03, -3.039E-04)	(-6.106E-05, -2.703E-04)	(5.246E-03, -1.340E-04)	(-8.833E-05, 5.076E-04)
2	(1.217E-03, 3.039E-04)	(-6.106E-05, 2.703E-04)	(5.246E-03, 1.340E-04)	(-8.833E-05, -5.076E-04)
3	(-1.288E-03, 3.053E-04)	(1.750E-04, 3.985E-04)	(-8.557E-03, 3.537E-03)	(1.633E-04, -1.888E-04)
4	(-1.288E-03, -3.053E-04)	(1.750E-04, -3.985E-04)	(-8.557E-03, -3.537E-03)	(1.633E-04, 1.888E-04)
5	(2.557E-09, -3.249E-09)	(-1.999E-09, -7.344E-10)	(1.658E-08, -4.387E-08)	(-1.730E-09, 5.918E-10)
6	(2.557E-09, 3.249E-09)	(-1.999E-09, 7.344E-10)	(1.658E-08, 4.387E-08)	(-1.730E-09, -5.918E-10)
7	(-1.859E-01, 1.010E-01)	(1.760E-02, 2.748E-02)	(-2.552E-01, 1.357E-01)	(9.740E-03, -5.583E-03)
8	(-1.859E-01, -1.010E-01)	(1.760E-02, -2.748E-02)	(-2.552E-01, -1.357E-01)	(9.740E-03, 5.583E-03)
9	(-3.209E+00, 6.511E+00)	(2.256E-01, 2.177E-01)	(-7.507E-01, 2.432E-01)	(8.113E-02, -8.736E-02)
10	(-3.209E+00, -6.511E+00)	(2.256E-01, -2.177E-01)	(-7.507E-01, -2.432E-01)	(8.113E-02, 8.736E-02)
11	(4.694E+00, -3.741E+01)	(-9.196E-02, 4.140E-03)	(-4.209E-04, 7.106E-03)	(-8.983E-02, -1.505E-02)
12	(4.694E+00, 3.741E+01)	(-9.196E-02, -4.140E-03)	(-4.209E-04, -7.106E-03)	(-8.983E-02, 1.505E-02)
13	(-2.595E+00, 0.)	(-3.026E-01, 0.)	(2.017E+00, 0.)	(-2.241E-03, 0.)
14	(0.)	(0.)	(0.)	(0.)
15	(0.)	(0.)	(0.)	(0.)
	5	6	7	
1	(2.163E-03, -5.524E-04)	(2.497E-03, 5.018E-02)	(2.505E-01, 2.419E-01)	
2	(2.163E-03, 5.524E-04)	(2.497E-03, -5.018E-02)	(2.505E-01, -2.419E-01)	
3	(-2.302E-02, -8.370E-03)	(1.887E-01, -4.857E-01)	(-1.901E+00, -8.521E-01)	
4	(-2.302E-02, 8.370E-03)	(1.887E-01, 4.857E-01)	(-1.901E+00, 8.521E-01)	
5	(-2.472E-07, 1.140E-08)	(-2.006E-07, -5.447E-06)	(-9.473E-06, 2.999E-08)	
6	(-2.472E-07, -1.140E-08)	(-2.006E-07, 5.447E-06)	(-9.473E-06, -2.999E-08)	
7	(2.982E-01, -2.484E-01)	(-2.403E+00, 2.455E+00)	(6.910E+00, 6.281E+00)	
8	(2.982E-01, 2.484E-01)	(-2.403E+00, -2.455E+00)	(6.910E+00, -6.281E+00)	
9	(2.421E-01, 1.575E-01)	(-6.356E-01, 3.567E-01)	(3.768E+00, 4.403E+00)	
10	(2.421E-01, -1.575E-01)	(-6.356E-01, -3.567E-01)	(3.768E+00, -4.403E+00)	
11	(-9.165E-02, 1.768E-03)	(-2.371E-04, 7.084E-03)	(3.252E-02, -2.055E-01)	
12	(-9.165E-02, -1.768E-03)	(-2.371E-04, -7.084E-03)	(3.252E-02, 2.055E-01)	
13	(-8.557E-01, 0.)	(5.705E+00, 0.)	(-1.575E+01, 0.)	
14	(0.)	(0.)	(0.)	
15	(0.)	(0.)	(0.)	

CONTROL RESIDUE MATRIX (15 BY 7)
OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

1	(1.254E-03, -1.402E+01)	(2.776E-04, -1.027E+02)	(6.248E-03, -1.229E+00)	(5.153E-04, 9.987E+01)
2	(1.254E-03, 1.402E+01)	(2.776E-04, 1.027E+02)	(6.248E-03, 1.229E+00)	(5.153E-04, -9.987E+01)
3	(1.323E-03, 1.667E+02)	(4.353E-04, 6.629E+01)	(9.259E-03, 1.575E+02)	(2.496E-04, -4.914E+01)
4	(1.323E-03, -1.667E+02)	(4.353E-04, -6.629E+01)	(9.259E-03, -1.575E+02)	(2.496E-04, 4.914E+01)
5	(4.132E-09, -5.184E+01)	(2.130E-09, -1.598E+02)	(4.689E-08, -6.930E+01)	(1.828E-09, 1.611E+02)
6	(4.132E-09, 5.184E+01)	(2.130E-09, 1.598E+02)	(4.689E-08, 6.930E+01)	(1.828E-09, -1.611E+02)
7	(2.115E-01, 1.515E+02)	(3.263E-02, 5.736E+01)	(2.890E-01, 1.520E+02)	(1.123E-02, -2.982E+01)
8	(2.115E-01, -1.515E+02)	(3.263E-02, -5.736E+01)	(2.890E-01, -1.520E+02)	(1.123E-02, 2.982E+01)
9	(7.259E+00, 1.162E+02)	(3.135E-01, 4.398E+01)	(7.910E-01, 1.616E+02)	(1.192E-01, -4.712E+01)
10	(7.259E+00, -1.162E+02)	(3.135E-01, -4.398E+01)	(7.910E-01, -1.616E+02)	(1.192E-01, 4.712E+01)
11	(3.770E+01, -8.285E+01)	(9.206E-02, 1.774E+02)	(7.118E-03, -9.339E+01)	(9.108E-02, -1.705E+02)
12	(3.770E+01, 8.285E+01)	(9.206E-02, -1.774E+02)	(7.118E-03, 9.339E+01)	(9.108E-02, 1.705E+02)
13	(2.598E+00, 1.800E+02)	(3.026E-01, 1.800E+02)	(2.017E+00, 0.)	(2.241E-03, 1.800E+02)
14	(0.)	(0.)	(0.)	(0.)
15	(0.)	(0.)	(0.)	(0.)
1	(2.233E-03, -1.433E+01)	(5.024E-02, 8.715E+01)	(3.483E-01, 4.400E+01)	(3.483E-01, -4.400E+01)
2	(2.233E-03, 1.433E+01)	(5.024E-02, -8.715E+01)	(3.483E-01, -4.400E+01)	(3.483E-01, 4.400E+01)
3	(2.450E-02, -1.600E+02)	(5.211E-01, -6.877E+01)	(2.084E+00, -1.559E+02)	(2.084E+00, 1.559E+02)
4	(2.450E-02, 1.600E+02)	(5.211E-01, 6.877E+01)	(2.084E+00, 1.559E+02)	(2.084E+00, -1.559E+02)
5	(2.475E-07, 1.774E+02)	(5.450E-06, -9.211E+01)	(9.473E-06, 1.798E+02)	(9.473E-06, -1.798E+02)
6	(2.475E-07, -1.774E+02)	(5.450E-06, 9.211E+01)	(9.473E-06, -1.798E+02)	(9.473E-06, 1.798E+02)
7	(3.882E-01, 3.975E+01)	(3.439E+00, 1.344E+02)	(9.340E+00, 4.228E+01)	(9.340E+00, -4.228E+01)
8	(3.882E-01, -3.975E+01)	(3.439E+00, -1.344E+02)	(9.340E+00, -4.228E+01)	(9.340E+00, 4.228E+01)
9	(2.888E-01, 3.305E+01)	(7.299E-01, 1.507E+02)	(5.795E+00, 4.944E+01)	(5.795E+00, -4.944E+01)
10	(2.888E-01, -3.305E+01)	(7.299E-01, -1.507E+02)	(5.795E+00, -4.944E+01)	(5.795E+00, 4.944E+01)
11	(9.157E-02, 1.789E+02)	(7.088E-03, -9.192E+01)	(2.080E-01, -8.101E+01)	(2.080E-01, 8.101E+01)
12	(9.157E-02, -1.789E+02)	(7.088E-03, 9.192E+01)	(2.080E-01, 8.101E+01)	(2.080E-01, -8.101E+01)
13	(9.557E-01, 1.800E+02)	(5.705E+00, 0.)	(1.579E+01, 1.800E+02)	(1.579E+01, -1.800E+02)
14	(0.)	(0.)	(0.)	(0.)
15	(0.)	(0.)	(0.)	(0.)

THE D-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(-6.692E-05, -4.115E-05)	(-9.449E-06, 1.460E-05)	(-2.797E-04, -2.738E-04)	(2.660E-05, -1.829E-05)
2	(-6.692E-05, 4.115E-05)	(-9.449E-06, -1.460E-05)	(-2.797E-04, 2.738E-04)	(2.660E-05, 1.829E-05)
3	(-1.480E-05, 1.624E-06)	(1.402E-06, 4.693E-06)	(-1.005E-04, 2.763E-05)	(2.086E-06, -1.882E-06)
4	(-1.480E-05, -1.624E-06)	(1.402E-06, -4.693E-06)	(-1.005E-04, -2.763E-05)	(2.086E-06, 1.882E-06)
5	(3.820E-09, 1.086E-05)	(-7.570E-11, -2.045E-09)	(4.504E-08, -1.250E-05)	(-1.157E-09, -1.322E-09)
6	(3.820E-09, -1.086E-05)	(-7.570E-11, 2.045E-09)	(4.504E-08, 1.250E-05)	(-1.157E-09, 1.322E-09)
7	(-3.170E-04, -2.220E-05)	(9.435E-08, 4.901E-05)	(-4.328E-04, -3.435E-05)	(1.684E-05, 7.974E-07)
8	(-3.170E-04, 2.220E-05)	(9.435E-08, -4.901E-05)	(-4.328E-04, 3.435E-05)	(1.684E-05, -7.974E-07)
9	(-8.721E-03, 4.637E-03)	(7.594E-05, 4.198E-04)	(-1.027E-03, -3.219E-04)	(1.591E-04, -3.194E-05)
10	(-8.721E-03, -4.637E-03)	(7.594E-05, -4.198E-04)	(-1.027E-03, 3.219E-04)	(1.591E-04, 3.194E-05)
11	(8.513E-03, -4.923E-04)	(-4.701E-06, -2.030E-05)	(1.564E-06, -3.857E-07)	(-3.403E-07, -2.061E-05)
12	(8.513E-03, 4.923E-04)	(-4.701E-06, 2.030E-05)	(1.564E-06, 3.857E-07)	(-3.403E-07, 2.061E-05)
13	(0, 0)	(0, 0)	(0, 0)	(0, 0)
14	(-8.295E-02, 0)	(-2.487E-02, 0)	(2.363E-01, 0)	(-2.546E-02, 0)
15	(8.415E-02, 0)	(2.475E-02, 0)	(-2.326E-01, 0)	(2.505E-02, 0)
	5	6	7	
1	(-1.195E-04, -7.264E-05)	(2.137E-03, -2.311E-03)	(-1.467E-04, -2.182E-02)	
2	(-1.195E-04, 7.264E-05)	(2.137E-03, 2.311E-03)	(-1.467E-04, 2.182E-02)	
3	(-2.455E-04, -1.254E-04)	(2.781E-03, -5.162E-03)	(-2.005E-02, -1.216E-02)	
4	(-2.455E-04, 1.254E-04)	(2.781E-03, 5.162E-03)	(-2.005E-02, 1.216E-02)	
5	(-1.003E-07, -2.157E-07)	(4.769E-05, -2.164E-06)	(-3.480E-06, -8.411E-06)	
6	(-1.003E-07, 2.157E-07)	(4.769E-05, 2.164E-06)	(-3.480E-06, 8.411E-06)	
7	(1.770E-04, 5.556E-04)	(-5.032E-03, 1.164E-03)	(3.675E-03, 1.354E-02)	
8	(1.770E-04, -5.556E-04)	(-5.032E-03, -1.164E-03)	(3.675E-03, -1.354E-02)	
9	(1.421E-04, 3.665E-04)	(-9.855E-04, -1.117E-04)	(6.593E-04, 7.858E-03)	
10	(1.421E-04, -3.665E-04)	(-9.855E-04, 1.117E-04)	(6.593E-04, -7.858E-03)	
11	(-4.160E-06, -2.033E-05)	(1.567E-06, -3.439E-07)	(4.707E-05, -1.205E-06)	
12	(-4.160E-06, 2.033E-05)	(1.567E-06, 3.439E-07)	(4.707E-05, 1.205E-06)	
13	(0, 0)	(0, 0)	(0, 0)	
14	(-3.130E-02, 0)	(2.973E-01, 0)	(3.262E+00, 0)	
15	(3.140E-02, 0)	(-2.951E-01, 0)	(-3.176E+00, 0)	

DISTURBANCE RESIDUE MATRIX (15 BY 7)
 OUTPUT FOR: (MAGNITUDE , PHASE(DEC.))

1	(7.856E-05, -1.481E+02)	(1.739E-05, 1.229E+02)	(3.914E-04, -1.356E+02)	(3.228E-05, -3.452E+01)	4
2	(7.856E-05, 1.491E+02)	(1.739E-05, -1.229E+02)	(3.914E-04, 1.356E+02)	(3.228E-05, 3.452E+01)	
3	(1.489E-05, 1.731E+02)	(4.898E-06, 7.337E+01)	(1.042E-04, 1.646E+02)	(2.803E-06, -4.206E+01)	
4	(1.489E-05, -1.731E+02)	(4.858E-06, -7.337E+01)	(1.042E-04, -1.646E+02)	(2.803E-06, 4.206E+01)	
5	(3.971E-05, 1.527E+01)	(2.046E-09, -9.212E+01)	(4.505E-08, -1.590E+00)	(1.757E-09, -1.312E+02)	
6	(3.971E-05, -1.527E+01)	(2.046E-09, 9.212E+01)	(4.505E-08, 1.590E+00)	(1.757E-09, 1.312E+02)	
7	(3.176E-04, -1.750E+02)	(4.501E-05, 8.989E+01)	(4.342E-04, -1.755E+02)	(1.686E-05, 2.710E+00)	
8	(3.176E-04, 1.750E+02)	(4.501E-05, -8.989E+01)	(4.342E-04, 1.755E+02)	(1.686E-05, -2.710E+00)	
9	(9.877E-03, 1.520E+02)	(4.265E-04, 7.975E+01)	(1.075E-03, -1.625E+02)	(1.622E-04, -1.135E+01)	
10	(9.877E-03, -1.520E+02)	(4.265E-04, -7.975E+01)	(1.075E-03, 1.625E+02)	(1.622E-04, 1.135E+01)	
11	(6.533E-05, -3.308E+00)	(2.094E-05, -1.030E+02)	(1.611E-06, -1.385E+01)	(2.062E-05, -9.095E+01)	
12	(6.533E-05, 3.308E+00)	(2.094E-05, 1.030E+02)	(1.611E-06, 1.385E+01)	(2.062E-05, 9.095E+01)	
13	(0.298E-02, 0.)	(0.)	(0.)	(0.)	
14	(6.298E-02, 1.800E+02)	(2.487E-02, 1.800E+02)	(2.363E-01, 0.)	(2.548E-02, 1.800E+02)	
15	(6.418E-02, 0.)	(2.445E-02, 0.)	(2.325E-01, 1.800E+02)	(2.505E-02, 0.)	
1	(1.399E-04, -1.487E+02)	(3.147E-03, -4.724E+01)	(2.182E-02, -9.039E+01)	(2.182E-02, -9.039E+01)	7
2	(1.399E-04, 1.437E+02)	(3.147E-03, 4.724E+01)	(2.182E-02, 9.039E+01)	(2.182E-02, 9.039E+01)	
3	(2.757E-04, -1.529E+02)	(5.854E-03, -6.169E+01)	(2.345E-02, -1.463E+02)	(2.345E-02, -1.463E+02)	
4	(2.757E-04, 1.529E+02)	(5.854E-03, 6.169E+01)	(2.345E-02, 1.463E+02)	(2.345E-02, 1.463E+02)	
5	(2.376E-07, -1.145E+02)	(5.237E-06, -2.440E+01)	(9.103E-05, -1.125E+02)	(9.103E-05, -1.125E+02)	
6	(2.376E-07, 1.145E+02)	(5.237E-06, 2.440E+01)	(9.103E-05, 1.125E+02)	(9.103E-05, 1.125E+02)	
7	(5.831E-04, 7.232E+01)	(5.165E-03, 1.670E+02)	(1.405E-02, 7.481E+01)	(1.405E-02, 7.481E+01)	
8	(5.831E-04, -7.232E+01)	(5.165E-03, -1.670E+02)	(1.405E-02, -7.481E+01)	(1.405E-02, -7.481E+01)	
9	(3.931E-04, 6.881E+01)	(9.918E-04, -1.735E+02)	(7.886E-03, 8.920E+01)	(7.886E-03, 8.920E+01)	
10	(3.931E-04, -6.881E+01)	(9.918E-04, 1.735E+02)	(7.886E-03, -8.920E+01)	(7.886E-03, -8.920E+01)	
11	(2.075E-05, -1.016E+02)	(1.604E-06, -1.231E+01)	(4.705E-05, -1.487E+00)	(4.705E-05, -1.487E+00)	
12	(2.075E-05, 1.016E+02)	(1.604E-06, 1.231E+01)	(4.705E-05, 1.487E+00)	(4.705E-05, 1.487E+00)	
13	(0.)	(0.)	(0.)	(0.)	
14	(3.130E-02, 1.800E+02)	(2.973E-01, 0.)	(3.262E+00, 0.)	(3.262E+00, 0.)	
15	(3.140E-02, 0.)	(2.995E-01, 1.800E+02)	(3.178E+00, 1.800E+02)	(3.178E+00, 1.800E+02)	

CONFIGURATION 3

THE AU MATRIX (12 BY 12)

1	-1.208E+00	9.440E-01	-6.340E-04	0.	0.	-8.940E-03	9.525E-02
2	-7.059E+00	-2.018E+03	-2.290E-03	0.	0.	-1.842E-01	-1.248E-01
3	-2.500E-01	0.	-2.500E-02	-3.220E+01	0.	0.	0.
4	0.	1.000E+00	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.
9	-7.383E+02	-1.333E+02	-1.435E-03	0.	0.	-3.066E+01	-1.568E+01
10	1.300E+03	1.633E+01	0.	0.	0.	1.407E+01	-5.061E+02
11	7.577E+02	5.595E+01	-3.900E-03	0.	0.	6.990E+00	3.458E+01
12	1.628E+00	3.990E-02	0.	0.	0.	1.623E-02	-9.700E-02

1	4.618E-03	-4.346E-03	-2.130E-04	2.590E-03	1.526E-04	1.526E-04	-4.998E-06
2	2.072E-01	-5.171E-02	-7.438E-03	4.972E-02	6.963E-03	6.963E-03	-2.001E-03
3	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	1.000E+00	0.	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.	0.	0.
7	0.	0.	0.	0.	1.000E+00	0.	0.
8	0.	0.	0.	0.	0.	1.000E+00	0.
9	-1.540E+01	2.088E+01	-8.418E-01	-2.770E-01	9.159E-01	9.159E-01	-1.977E-01
10	6.593E+00	1.124E+01	2.351E-01	-8.596E+00	1.131E-01	1.131E-01	1.120E-01
11	-4.565E+02	3.457E+00	-1.219E-01	3.784E+00	-8.435E-01	-8.435E-01	-2.535E-01
12	7.112E-03	-4.849E+02	-3.290E-04	2.427E-03	-2.764E-04	-2.764E-04	-4.080E-01

THE AG MATRIX (2 BY 2)

1	-9.400E+00	0.
2	-2.256E-02	-9.500E+00

THE B VECTOR (12 BY 1)

1
-2.884E-01
2
-1.503E+01
3
0.
4
0.
5
0.
6
0.
7
0.
8
0.
9
-2.230E+03
10
-2.152E+02
11
6.136E+02
12
1.079E-01

THE C MATRIX (7 BY 12)

	1	2	3	4	5	6
1	0.	0.	1.000E+00	0.	0.	0.
2	0.	0.	0.	1.000E+00	0.	0.
3	0.	1.000E+00	0.	0.	0.	0.
4	-1.000E+00	0.	0.	1.000E+00	0.	0.
5	0.	0.	0.	0.	2.640E-02	3.300E-02
6	0.	1.000E+00	0.	0.	0.	0.
7	9.322E+00	-1.395E+00	1.423E-02	0.	1.917E-02	3.214E+00
				10	11	12
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	3.636E-02	0.	0.	0.	0.
5	3.456E-02	0.	2.640E-02	3.300E-02	3.456E-02	3.636E-02
6	0.	0.	1.103E-01	2.627E-03	1.441E-04	0.
7	2.911E+00	1.672E+00	-1.483E-03	0.	0.	0.

THE D MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	-7.371E+02
10	0.	1.298E+03
11	0.	7.564E+02
12	0.	1.697E+00

THE E VECTOR (7 BY 1)

1
1
2
3
4
5
6
7

THE F MATRIX (7 BY 2)

	1	2
1	0.	0.
2	0.	0.
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	9.243E+00

THE GG VECTOR (15 BY 1)

1 0.
2 1.000E+00
3 5.321E-03
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

AP = -6.667E+00

THE GP VECTOR (15 BY 1)

1 1.000E+00
2 0.
3 0.
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

THE AU-SCALED MATRIX (12 BY 12)

	1	2	3	4	5	6
1	-1.208E+00	9.440E-01	-6.017E-01	0.	3.386E-01	-2.886E+00
2	-7.359E+00	-2.018E+00	-2.173E+00	0.	6.977E+00	3.782E+00
3	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.	0.
4	0.	1.000E+00	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	1.949E+01	3.519E+00	3.595E-02	0.	-3.066E+01	-1.254E+01
10	-4.290E+01	-5.389E-01	0.	0.	1.759E+01	-5.061E+02
11	-2.619E+01	-1.934E+00	1.279E-01	0.	9.151E+00	3.621E+01
12	-6.138E-02	-1.451E-03	0.	0.	2.235E-02	-1.069E-01

	7	8	9	10	11	12
1	-1.336E-01	1.195E-01	8.068E-03	-7.848E-02	-4.416E-03	1.375E-04
2	-5.995E+00	2.522E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	1.000E+00	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.	0.
7	0.	0.	0.	0.	1.000E+00	0.
8	0.	0.	0.	0.	0.	1.000E+00
9	-1.176E+01	1.516E+01	-8.418E-01	-2.216E-01	6.996E-01	-1.435E-01
10	6.295E+00	1.020E+01	2.939E-01	-8.596E+00	1.080E-01	1.017E-01
11	-4.565E+02	3.235E+00	-1.596E-01	3.963E+00	-8.435E-01	-2.410E-01
12	7.432E-03	-4.849E+02	-4.531E-04	2.674E-03	-2.908E-04	-4.080E-01

THE B-SCALED VECTOR (12 BY 1)

	1
1	-2.884E-01
2	-1.503E+01
3	0.
4	0.
5	0.
6	0.
7	0.
8	0.
9	5.886E+01
10	7.103E+00
11	2.120E+01
12	-3.921E-03

THE C-SCALED MATRIX (7 BY 12)

	1	2	3	4	5	6
1	0.	0.	9.490E+02	0.	0.	0.
2	0.	0.	0.	1.000E+00	0.	0.
3	0.	1.000E+00	0.	0.	0.	0.
4	-1.000E+00	0.	0.	1.000E+00	0.	0.
5	0.	0.	0.	1.000E+00	-1.000E+00	-1.000E+00
6	0.	1.000E+00	0.	0.	0.	0.
7	9.322E+00	-1.395E+00	1.350E+01	0.	-7.260E-01	-9.740E+01

	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	-1.000E+00	-1.000E+00	0.	0.	0.	0.
6	0.	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-8.424E+01	-4.599E+01	5.616E-02	-3.342E+00	-7.602E-02	-3.964E-03

THE D-SCALED MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	1.946E+01
9	0.	-4.283E+01
10	0.	-2.614E+01
11	0.	-6.170E-02
12	0.	0.

THE AA MATRIX (15 BY 15)

	1	2	3	4	5	6	7	8
1	-6.667E+00	0.	0.	0.	0.	0.	0.	0.
2	0.	-9.400E+00	0.	0.	0.	0.	0.	0.
3	0.	-2.256E-02	-9.500E+00	0.	0.	0.	0.	0.
4	-2.884E-01	0.	-1.204E+00	-1.208E+00	9.440E-01	-6.017E-01	0.	3.386E-01
5	-1.503E+01	0.	-7.049E+00	-7.059E+00	-2.018E+00	-2.173E+00	0.	6.977E+00
6	0.	0.	0.	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.
7	0.	0.	0.	0.	1.000E+00	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.
12	5.886E+01	0.	1.946E+01	1.949E+01	3.519E+00	3.595E-02	0.	-3.066E+01
13	7.103E+00	0.	-4.283E+01	-4.290E+01	-5.389E-01	0.	0.	1.759E+01
14	-2.120E+01	0.	-2.614E+01	-2.619E+01	-1.934E+00	1.279E-01	0.	9.151E+00
15	-3.921E-03	0.	-6.170E-02	-6.138E-02	-1.451E-03	0.	0.	2.235E-02
	9	10	11	12	13	14	15	
1	0.	0.	0.	0.	0.	0.	0.	
2	0.	0.	0.	0.	0.	0.	0.	
3	0.	0.	0.	0.	0.	0.	0.	
4	-2.886E+00	-1.336E-01	1.195E-01	8.068E-03	-7.846E-02	-4.416E-03	1.375E-04	
5	3.782E+00	-5.995E+00	2.522E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02	
6	0.	0.	0.	0.	0.	0.	0.	
7	0.	0.	0.	0.	0.	0.	0.	
8	0.	0.	0.	1.000E+00	0.	0.	0.	
9	0.	0.	0.	0.	1.000E+00	0.	0.	
10	0.	0.	0.	0.	0.	1.000E+00	0.	
11	0.	0.	0.	0.	0.	0.	1.000E+00	
12	-1.254E+01	-1.176E+01	1.116E+01	-3.418E-01	-2.216E-01	6.996E-01	-1.435E-01	
13	-5.061E+02	6.295E+00	2.939E-01	2.939E-01	-8.596E+00	1.080E-01	1.017E-01	
14	3.621E+01	-4.565E+02	3.286E+00	-1.556E-01	3.963E+00	-8.495E-01	-2.410E-01	
15	-1.059E-01	7.482E-03	-4.849E+02	-4.531E-04	2.674E-03	-2.908E-04	-4.080E-01	

THE CC MATRIX (7 BY 15)

	1	2	3	4	5
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	1.000E+00
4	0.	0.	-1.000E+00	0.	0.
5	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	1.000E+00
7	2.327E+00	0.	9.243E+00	9.322E+00	-1.395E+00

	6	7	8	9	10
1	9.490E+02	0.	0.	0.	0.
2	0.	1.000E+00	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	1.000E+00	0.	0.	0.
5	0.	1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
6	0.	0.	0.	0.	0.
7	1.350E+01	0.	-7.260E-01	-9.740E+01	-8.424E+01

	11	12	13	14	15
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.
5	-1.000E+00	0.	0.	0.	0.
6	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-4.599E+01	5.616E-02	-3.342E+00	-7.602E-02	-3.964E-03

SPECTRAL DECOMPOSITION OF A-AUG

	REAL PART	IMAGINARY PART	FREQUENCY (HERTZ)	DAMPING RATIO	TIME CONST. (SEC/RAD)
1	-4.47811E+00	2.20547E+01	3.58173E+00	.19898534	2.23309E-01
3	-4.61593E-01	2.12686E+01	3.38579E+00	.02169795	2.16641E+00
5	-2.03802E-01	2.20195E+01	3.50467E+00	.00925509	4.90673E+00
7	-1.05452E+00	5.86292E+00	9.48087E-01	.17702179	9.48299E-01
9	-7.84790E-01	1.50233E+00	2.69761E-01	.46301446	1.27423E+00
11	-5.22323E-02	0.	0.	1.00000000	1.91452E+01
12	7.25518E-02	0.	0.	-1.00000000	-1.37832E+01
13	-6.66667E+00	0.	0.	1.00000000	1.50000E-01
14	-9.50000E+00	0.	0.	1.00000000	1.05263E-01
15	-9.40000E+00	0.	0.	1.00000000	1.06332E-01

THE EE MATRIX (15 BY 15)

	1	2	3	4
1	(0.)	(0.)	(0.)	(0.)
2	(0.)	(0.)	(0.)	(0.)
3	(0.)	(0.)	(0.)	(0.)
4	(-1.080E-03, 7.881E-03)	(-1.080E-03, -7.881E-03)	(-7.057E-04, -9.358E-04)	(-7.057E-04, 9.358E-04)
5	(-6.360E-02, -5.041E-03)	(-6.360E-02, 5.041E-03)	(9.643E-03, -1.577E-02)	(9.643E-03, 1.577E-02)
6	(-1.335E-05, 1.934E-06)	(-1.335E-05, -1.934E-06)	(1.813E-06, -2.109E-06)	(1.813E-06, 2.109E-06)
7	(3.428E-04, 2.814E-03)	(3.428E-04, -2.814E-03)	(-7.509E-04, -4.371E-04)	(-7.509E-04, 4.371E-04)
8	(1.432E-03, 2.009E-04)	(1.432E-03, -2.009E-04)	(-1.080E-03, 2.102E-03)	(-1.080E-03, -2.102E-03)
9	(3.896E-02, -8.456E-03)	(3.896E-02, 8.456E-03)	(-3.856E-04, 1.810E-03)	(-3.856E-04, -1.810E-03)
10	(-1.764E-02, 7.742E-03)	(-1.764E-02, -7.742E-03)	(-4.603E-02, 8.753E-03)	(-4.603E-02, -8.753E-03)
11	(-1.767E-05, 1.985E-05)	(-1.767E-05, -1.985E-05)	(-1.165E-05, 4.415E-06)	(-1.165E-05, -4.415E-06)
12	(-1.084E-02, 3.068E-02)	(-1.084E-02, -3.068E-02)	(-4.421E-02, 2.395E-02)	(-4.421E-02, -2.395E-02)
13	(1.228E-02, 8.971E-01)	(1.228E-02, -8.971E-01)	(-3.831E-02, -9.037E-03)	(-3.831E-02, 9.037E-03)
14	(-9.176E-02, -4.237E-01)	(-9.176E-02, 4.237E-01)	(-1.649E-01, -9.829E-01)	(-1.649E-01, 9.829E-01)
15	(5.172E-04, -3.007E-04)	(5.172E-04, 3.007E-04)	(-8.849E-05, -2.507E-04)	(-8.849E-05, 2.507E-04)
	5	6	7	8
1	(0.)	(0.)	(0.)	(0.)
2	(0.)	(0.)	(0.)	(0.)
3	(0.)	(0.)	(0.)	(0.)
4	(1.637E-04, 6.252E-05)	(1.637E-04, -6.252E-05)	(-2.253E-02, -3.297E-02)	(-2.253E-02, 3.297E-02)
5	(3.601E-03, 4.803E-03)	(3.601E-03, -4.803E-03)	(1.743E-01, -1.555E-01)	(1.743E-01, 1.555E-01)
6	(1.846E-07, 5.281E-07)	(1.846E-07, -5.281E-07)	(2.319E-04, -3.206E-04)	(2.319E-04, 3.206E-04)
7	(2.166E-04, -1.655E-04)	(2.166E-04, 1.655E-04)	(-3.087E-02, -2.417E-02)	(-3.087E-02, 2.417E-02)
8	(3.781E-05, -1.826E-03)	(3.781E-05, 1.826E-03)	(1.441E-01, 7.017E-02)	(1.441E-01, -7.017E-02)
9	(1.244E-03, 1.429E-03)	(1.244E-03, -1.429E-03)	(7.517E-03, 5.835E-03)	(7.517E-03, -5.835E-03)
10	(2.381E-03, -1.191E-02)	(2.381E-03, 1.191E-02)	(4.098E-03, 4.513E-03)	(4.098E-03, -4.513E-03)
11	(-1.887E-02, 3.934E-02)	(-1.887E-02, -3.934E-02)	(8.119E-06, 6.776E-06)	(8.119E-06, -6.776E-06)
12	(4.020E-02, 1.205E-03)	(4.020E-02, -1.205E-03)	(-5.634E-01, 7.710E-01)	(-5.634E-01, -7.710E-01)
13	(3.172E-02, 2.709E-02)	(3.172E-02, -2.709E-02)	(-4.214E-02, 3.792E-02)	(-4.214E-02, -3.792E-02)
14	(2.619E-01, 5.485E-02)	(2.619E-01, -5.485E-02)	(-3.312E-02, 1.884E-02)	(-3.312E-02, -1.884E-02)
15	(-8.624E-01, -4.234E-01)	(-8.624E-01, 4.234E-01)	(-4.830E-05, 4.046E-05)	(-4.830E-05, -4.046E-05)
	9	10	11	12
1	(0.)	(0.)	(0.)	(0.)
2	(0.)	(0.)	(0.)	(0.)
3	(0.)	(0.)	(0.)	(0.)
4	(-1.332E-01, -3.707E-01)	(-1.332E-01, 3.707E-01)	(4.297E-01, 0.)	(4.297E-01, 0.)
5	(5.673E-01, -2.111E-01)	(5.673E-01, 2.111E-01)	(3.710E-02, 0.)	(3.710E-02, 0.)
6	(6.121E-03, -1.142E-02)	(6.121E-03, 1.142E-02)	(-4.693E-01, 0.)	(-4.693E-01, 0.)
7	(-2.654E-01, -2.390E-01)	(-2.654E-01, 2.390E-01)	(-7.103E-01, 0.)	(-7.103E-01, 0.)
8	(-1.711E-02, -2.985E-01)	(-1.711E-02, 2.985E-01)	(2.962E-01, 0.)	(2.962E-01, 0.)
9	(1.106E-02, 2.174E-02)	(1.106E-02, -2.174E-02)	(-2.647E-02, 0.)	(-2.647E-02, 0.)
10	(5.237E-03, 1.792E-02)	(5.237E-03, -1.792E-02)	(-2.109E-02, 0.)	(-2.109E-02, 0.)
11	(1.132E-05, 2.923E-05)	(1.132E-05, -2.923E-05)	(-3.532E-05, 0.)	(-3.532E-05, 0.)
12	(4.624E-01, 2.086E-01)	(4.624E-01, -2.086E-01)	(-1.547E-02, 0.)	(-1.547E-02, 0.)
13	(-4.133E-02, -4.492E-04)	(-4.133E-02, 4.492E-04)	(3.82E-03, 0.)	(3.82E-03, 0.)

14	(-3.102E-02, -6.193E-03)	(-3.102E-02, 6.193E-03)	(1.101E-03, 0.	)	( 1.184E-03, 0.)
15	(-5.279E-05, -5.937E-06)	(-5.279E-05, 5.937E-06)	(1.845E-06, 0.	)	( 1.974E-06, 0.)
13						
1	(1.635E-01, 0.	(0.	(0.	)	( 0.)
2	(0.	(0.	(0.	)	( 8.557E-01, 0.)
3	(0.	(3.744E-01, 0.	(3.744E-01, 0.	)	(-1.930E-01, 0.)
4	(-4.240E-02, 0.	(1.926E-03, 0.	(1.926E-03, 0.	)	(-7.974E-04, 0.)
5	(2.772E-01, 0.	(3.690E-01, 0.	(3.690E-01, 0.	)	(-1.917E-01, 0.)
6	(-3.811E-04, 0.	(-1.337E-04, 0.	(-1.337E-04, 0.	)	( 7.158E-05, 0.)
7	(-4.167E-02, 0.	(-3.884E-02, 0.	(-3.884E-02, 0.	)	( 2.040E-02, 0.)
8	(1.397E-01, 0.	(8.199E-02, 0.	(8.199E-02, 0.	)	(-4.299E-02, 0.)
9	(1.014E-02, 0.	(-2.953E-02, 0.	(-2.953E-02, 0.	)	( 1.522E-02, 0.)
10	(-2.762E-03, 0.	(-1.788E-02, 0.	(-1.788E-02, 0.	)	( 9.247E-03, 0.)
11	(7.243E-06, 0.	(-3.123E-05, 0.	(-3.123E-05, 0.	)	( 1.612E-05, 0.)
12	(-9.317E-01, 0.	(-7.789E-01, 0.	(-7.789E-01, 0.	)	( 4.040E-01, 0.)
13	(-6.756E-02, 0.	(2.805E-01, 0.	(2.805E-01, 0.	)	(-1.431E-01, 0.)
14	(1.841E-02, 0.	(1.699E-01, 0.	(1.699E-01, 0.	)	(-8.692E-02, 0.)
15	(-4.822E-05, 0.	(2.967E-04, 0.	(2.967E-04, 0.	)	(-1.515E-04, 0.)
14						
			(0.	)	( 0.)
			(8.557E-01, 0.	)	( 8.557E-01, 0.)
			(-1.930E-01, 0.	)	(-1.930E-01, 0.)
			(-7.974E-04, 0.	)	(-7.974E-04, 0.)
			(-1.917E-01, 0.	)	(-1.917E-01, 0.)
			(7.158E-05, 0.	)	( 7.158E-05, 0.)
			(2.040E-02, 0.	)	( 2.040E-02, 0.)
			(-4.299E-02, 0.	)	(-4.299E-02, 0.)
			(1.522E-02, 0.	)	( 1.522E-02, 0.)
			(9.247E-03, 0.	)	( 9.247E-03, 0.)
			(1.612E-05, 0.	)	( 1.612E-05, 0.)
			(4.040E-01, 0.	)	( 4.040E-01, 0.)
			(-1.431E-01, 0.	)	(-1.431E-01, 0.)
			(-8.692E-02, 0.	)	(-8.692E-02, 0.)
			(-1.515E-04, 0.	)	(-1.515E-04, 0.)

THE CON VECTOR (15 BY 1)

```

1 (-1.038E-01, 9.252E-03)
2 (-1.038E-01, -9.252E-03)
3 (-4.006E-01, -2.906E-01)
4 (-4.006E-01, 2.906E-01)
5 (-6.106E-06, -2.496E-06)
6 (-6.106E-06, 2.496E-06)
7 (-3.810E+00, -1.001E+00)
8 (-3.810E+00, 1.001E+00)
9 (-1.082E-01, 1.693E-01)
10 (-1.082E-01, -1.693E-01)
11 ( 3.804E-02, 7.196E-31)
12 ( 5.303E-02, 7.217E-31)
13 ( 6.114E+00, 0. )
14 ( 0. , 0. )
15 ( 0. , 0. )

```

CONTROLABILITY MATRIX (15 BY 1)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1 ( 1.043E-01, 1.749E+02)
2 ( 1.043E-01, -1.749E+02)
3 ( 4.949E-01, -1.440E+02)
4 ( 4.949E-01, 1.440E+02)
5 ( 6.597E-06, -1.578E+02)
6 ( 6.597E-06, 1.578E+02)
7 ( 3.547E+00, -1.653E+02)
8 ( 3.547E+00, 1.653E+02)
9 ( 2.009E-01, 1.226E+02)
10 ( 2.009E-01, -1.226E+02)
11 ( 3.804E-02, 1.084E-27)
12 ( 5.303E-02, 7.798E-28)
13 ( 6.114E+00, 0. )
14 ( 0. , 0. )
15 ( 0. , 0. )

```

THE DIST VECTOR (15 BY 1)

```

1 ( 4.701E-03, 3.918E-03 )
2 ( 4.701E-03, -3.918E-03 )
3 ( -4.121E-03, -3.842E-03 )
4 ( -4.121E-03, 3.842E-03 )
5 ( 4.410E-06, -6.226E-06 )
6 ( 4.410E-06, 6.226E-06 )
7 ( -2.992E-03, -4.009E-03 )
8 ( -2.992E-03, 4.009E-03 )
9 ( -5.985E-04, -2.691E-04 )
10 ( -5.985E-04, 2.691E-04 )
11 ( -1.499E-05, -1.189E-30 )
12 ( 2.517E-05, -1.880E-30 )
13 ( 0. , 0. )
14 ( 6.177E-01, 0. )
15 ( 1.169E+00, 0. )

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DISTURBABILITY MATRIX (15 BY 1)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1 ( 6.120E-03, 3.981E+01 )
2 ( 6.120E-03, -3.981E+01 )
3 ( 5.634E-03, -1.370E+02 )
4 ( 5.634E-03, 1.370E+02 )
5 ( 7.629E-06, -5.469E+01 )
6 ( 7.629E-06, 5.469E+01 )
7 ( 5.003E-03, -1.267E+02 )
8 ( 5.003E-03, 1.267E+02 )
9 ( 6.562E-04, -1.558E+02 )
10 ( 6.562E-04, 1.558E+02 )
11 ( 1.499E-05, -1.800E+02 )
12 ( 2.517E-05, -4.280E-24 )
13 ( 0. , 0. )
14 ( 6.177E-01, 0. )
15 ( 1.169E+00, 0. )

```

THE OBS MATRIX (7 BY 15)

1	(-1.267E-02, 1.835E-03)	(-1.267E-02, -1.835E-03)	(1.721E-03, -2.002E-03)	(1.721E-03, 2.002E-03)
2	(3.428E-04, 2.814E-03)	(3.428E-04, -2.814E-03)	(-7.509E-04, -4.371E-04)	(-7.509E-04, 4.371E-04)
3	(-6.360E-02, -5.041E-03)	(-6.360E-02, 5.041E-03)	(9.643E-03, -1.577E-02)	(9.643E-03, 1.577E-02)
4	(1.422E-03, -5.067E-03)	(1.422E-03, 5.067E-03)	(-4.514E-05, 4.987E-04)	(-4.514E-05, -4.987E-04)
5	(-2.239E-02, 3.357E-03)	(-2.239E-02, -3.357E-03)	(4.675E-02, -1.311E-02)	(4.675E-02, 1.311E-02)
6	(2.621E-02, -5.067E-01)	(2.621E-02, 5.067E-01)	(2.572E-01, 1.000E+00)	(2.572E-01, -1.000E+00)
7	(-2.264E+00, -2.710E+00)	(-2.264E+00, 2.710E+00)	(4.034E+00, -7.985E-01)	(4.034E+00, 7.985E-01)
1	(1.752E-04, 5.012E-04)	(1.752E-04, -5.012E-04)	(2.199E-01, -3.042E-01)	(2.199E-01, 3.042E-01)
2	(2.166E-04, -1.655E-04)	(2.166E-04, 1.655E-04)	(-3.087E-02, -2.417E-02)	(-3.087E-02, 2.417E-02)
3	(3.601E-03, 4.803E-03)	(3.601E-03, -4.803E-03)	(1.743E-01, -1.555E-01)	(1.743E-01, 1.555E-01)
4	(5.285E-05, -2.201E-04)	(5.285E-05, 2.201E-04)	(-8.337E-03, 8.797E-03)	(-8.337E-03, -8.797E-03)
5	(1.542E-02, -2.719E-02)	(1.542E-02, 2.719E-02)	(-1.866E-01, -1.051E-01)	(-1.866E-01, 1.051E-01)
6	(5.566E-01, 3.451E-01)	(5.566E-01, -3.451E-01)	(8.130E-01, -9.833E-01)	(8.130E-01, 9.833E-01)
7	(6.341E-01, -1.042E+00)	(6.341E-01, 1.042E+00)	(-1.521E+00, -1.213E+00)	(-1.521E+00, 1.213E+00)
1	(5.808E+00, -1.081E+01)	(5.808E+00, 1.084E+01)	(-4.454E+02, 0.)	(3.589E+02, 0.)
2	(-2.654E-01, -2.390E-01)	(-2.654E-01, 2.390E-01)	(-7.103E-01, 0.)	(-8.306E-01, 0.)
3	(5.673E-01, -2.111E-01)	(5.673E-01, 2.111E-01)	(3.710E-02, 0.)	(-6.026E-02, 0.)
4	(-1.322E-01, -1.317E-01)	(-1.322E-01, 1.317E-01)	(-1.140E+00, 0.)	(-4.999E-01, 0.)
5	(-2.645E-01, 2.020E-02)	(-2.645E-01, -2.020E-02)	(-9.590E-01, 0.)	(-6.364E-01, 0.)
6	(1.775E-01, -4.133E-01)	(1.775E-01, 4.133E-01)	(5.009E-02, 0.)	(-4.618E-02, 0.)
7	(-3.290E+00, -6.712E+00)	(-3.290E+00, 6.712E+00)	(1.753E+00, 0.)	(-1.079E+00, 0.)
1	(-3.617E-01, 0.)	(-1.269E-01, 0.)	(6.793E-02, 0.)	
2	(-4.167E-02, 0.)	(-3.984E-02, 0.)	(2.040E-02, 0.)	
3	(2.778E-01, 0.)	(3.690E-01, 0.)	(-1.917E-01, 0.)	
4	(7.306E-04, 0.)	(-4.077E-02, 0.)	(2.119E-02, 0.)	
5	(-1.888E-01, 0.)	(-7.339E-02, 0.)	(3.883E-02, 0.)	
6	(1.255E+00, 0.)	(6.972E-01, 0.)	(-3.656E-01, 0.)	
7	(-1.092E+00, 0.)	(6.292E+00, 0.)	(-3.247E+00, 0.)	

OBSERVABILITY MATRIX (7 BY 15)
 OUTPUT FORM: (MAGNITUDE , PHASE (DEG.))

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1 ( 1.280E-02, 1.718E+02 ) ( 1.280E-02, -1.718E+02 ) ( 2.640E-03, -4.932E+01 ) ( 2.640E-03, 4.932E+01 )
2 ( 2.835E-03, 0.305E+01 ) ( 2.835E-03, -8.305E+01 ) ( 8.688E-04, -1.498E+02 ) ( 8.688E-04, 1.498E+02 )
3 ( 6.380E-02, -1.755E+02 ) ( 6.380E-02, 1.755E+02 ) ( 1.848E-02, -5.855E+01 ) ( 1.848E-02, 5.855E+01 )
4 ( 5.262E-03, -7.432E+01 ) ( 5.262E-03, 7.432E+01 ) ( 5.007E-04, -9.517E+01 ) ( 5.007E-04, 9.517E+01 )
5 ( 2.264E-02, -1.715E+02 ) ( 2.264E-02, 1.715E+02 ) ( 4.855E-02, -1.566E+01 ) ( 4.855E-02, 1.566E+01 )
6 ( 5.094E-01, -8.705E+01 ) ( 5.094E-01, 8.705E+01 ) ( 1.033E+00, -7.558E+01 ) ( 1.033E+00, 7.558E+01 )
7 ( 3.532E+00, -1.299E+02 ) ( 3.532E+00, 1.299E+02 ) ( 4.113E+00, -1.120E+01 ) ( 4.113E+00, 1.120E+01 )

5
1 ( 5.309E-04, 7.074E+01 ) ( 5.309E-04, -7.074E+01 ) ( 3.754E-01, -5.413E+01 ) ( 3.754E-01, 5.413E+01 )
2 ( 2.726E-04, -3.739E+01 ) ( 2.726E-04, 3.739E+01 ) ( 3.920E-02, -1.419E+02 ) ( 3.920E-02, 1.419E+02 )
3 ( 6.003E-03, 5.314E+01 ) ( 6.003E-03, -5.314E+01 ) ( 2.335E-01, -4.174E+01 ) ( 2.335E-01, 4.174E+01 )
4 ( 2.341E-04, -7.695E+01 ) ( 2.341E-04, 7.695E+01 ) ( 1.212E-02, -1.335E+02 ) ( 1.212E-02, 1.335E+02 )
5 ( 3.126E-02, -6.044E+01 ) ( 3.126E-02, 6.044E+01 ) ( 2.142E-01, -1.506E+02 ) ( 2.142E-01, 1.506E+02 )
6 ( 6.884E-01, 3.009E+01 ) ( 6.884E-01, -3.009E+01 ) ( 1.276E+00, -5.042E+01 ) ( 1.276E+00, 5.042E+01 )
7 ( 1.220E+00, -5.968E+01 ) ( 1.220E+00, 5.968E+01 ) ( 1.945E+00, -1.414E+02 ) ( 1.945E+00, 1.414E+02 )

9
1 ( 1.230E+01, -6.182E+01 ) ( 1.230E+01, 6.182E+01 ) ( 4.454E+02, 1.800E+02 ) ( 4.454E+02, -1.800E+02 )
2 ( 3.571E-01, -1.380E+02 ) ( 3.571E-01, 1.380E+02 ) ( 7.103E-01, 1.800E+02 ) ( 7.103E-01, -1.800E+02 )
3 ( 6.053E-01, -2.041E+01 ) ( 6.053E-01, 2.041E+01 ) ( 3.710E-02, 0. ) ( 3.710E-02, 0. )
4 ( 1.866E-01, 1.351E+02 ) ( 1.866E-01, -1.351E+02 ) ( 1.140E+00, 1.800E+02 ) ( 1.140E+00, -1.800E+02 )
5 ( 2.653E-01, -1.756E+02 ) ( 2.653E-01, 1.756E+02 ) ( 9.590E-01, 1.800E+02 ) ( 9.590E-01, -1.800E+02 )
6 ( 4.497E-01, -6.678E+01 ) ( 4.497E-01, 6.678E+01 ) ( 5.009E-02, 0. ) ( 5.009E-02, 0. )
7 ( 7.475E+00, -1.161E+02 ) ( 7.475E+00, 1.161E+02 ) ( 1.753E+00, 0. ) ( 1.753E+00, 0. )

11
1 ( 1.230E+01, -6.182E+01 ) ( 1.230E+01, 6.182E+01 ) ( 4.454E+02, 1.800E+02 ) ( 4.454E+02, -1.800E+02 )
2 ( 3.571E-01, -1.380E+02 ) ( 3.571E-01, 1.380E+02 ) ( 7.103E-01, 1.800E+02 ) ( 7.103E-01, -1.800E+02 )
3 ( 6.053E-01, -2.041E+01 ) ( 6.053E-01, 2.041E+01 ) ( 3.710E-02, 0. ) ( 3.710E-02, 0. )
4 ( 1.866E-01, 1.351E+02 ) ( 1.866E-01, -1.351E+02 ) ( 1.140E+00, 1.800E+02 ) ( 1.140E+00, -1.800E+02 )
5 ( 2.653E-01, -1.756E+02 ) ( 2.653E-01, 1.756E+02 ) ( 9.590E-01, 1.800E+02 ) ( 9.590E-01, -1.800E+02 )
6 ( 4.497E-01, -6.678E+01 ) ( 4.497E-01, 6.678E+01 ) ( 5.009E-02, 0. ) ( 5.009E-02, 0. )
7 ( 7.475E+00, -1.161E+02 ) ( 7.475E+00, 1.161E+02 ) ( 1.753E+00, 0. ) ( 1.753E+00, 0. )

12
1 ( 1.230E+01, -6.182E+01 ) ( 1.230E+01, 6.182E+01 ) ( 4.454E+02, 1.800E+02 ) ( 4.454E+02, -1.800E+02 )
2 ( 3.571E-01, -1.380E+02 ) ( 3.571E-01, 1.380E+02 ) ( 7.103E-01, 1.800E+02 ) ( 7.103E-01, -1.800E+02 )
3 ( 6.053E-01, -2.041E+01 ) ( 6.053E-01, 2.041E+01 ) ( 3.710E-02, 0. ) ( 3.710E-02, 0. )
4 ( 1.866E-01, 1.351E+02 ) ( 1.866E-01, -1.351E+02 ) ( 1.140E+00, 1.800E+02 ) ( 1.140E+00, -1.800E+02 )
5 ( 2.653E-01, -1.756E+02 ) ( 2.653E-01, 1.756E+02 ) ( 9.590E-01, 1.800E+02 ) ( 9.590E-01, -1.800E+02 )
6 ( 4.497E-01, -6.678E+01 ) ( 4.497E-01, 6.678E+01 ) ( 5.009E-02, 0. ) ( 5.009E-02, 0. )
7 ( 7.475E+00, -1.161E+02 ) ( 7.475E+00, 1.161E+02 ) ( 1.753E+00, 0. ) ( 1.753E+00, 0. )

13
1 ( 3.617E-01, 1.800E+02 ) ( 3.617E-01, -1.800E+02 ) ( 6.793E-02, 0. ) ( 6.793E-02, 0. )
2 ( 4.167E-02, 1.800E+02 ) ( 4.167E-02, -1.800E+02 ) ( 2.040E-02, 0. ) ( 2.040E-02, 0. )
3 ( 2.778E-01, 0. ) ( 2.778E-01, 0. ) ( 1.917E-01, 1.800E+02 ) ( 1.917E-01, -1.800E+02 )
4 ( 7.306E-04, 0. ) ( 7.306E-04, 0. ) ( 2.119E-02, 0. ) ( 2.119E-02, 0. )
5 ( 1.888E-01, 1.800E+02 ) ( 1.888E-01, -1.800E+02 ) ( 3.889E-02, 0. ) ( 3.889E-02, 0. )
6 ( 1.259E+00, 0. ) ( 1.259E+00, 0. ) ( 3.656E-01, 1.800E+02 ) ( 3.656E-01, -1.800E+02 )
7 ( 1.092E+00, 1.800E+02 ) ( 1.092E+00, -1.800E+02 ) ( 3.247E+00, 1.800E+02 ) ( 3.247E+00, -1.800E+02 )

14
1 ( 3.617E-01, 1.800E+02 ) ( 3.617E-01, -1.800E+02 ) ( 6.793E-02, 0. ) ( 6.793E-02, 0. )
2 ( 4.167E-02, 1.800E+02 ) ( 4.167E-02, -1.800E+02 ) ( 2.040E-02, 0. ) ( 2.040E-02, 0. )
3 ( 2.778E-01, 0. ) ( 2.778E-01, 0. ) ( 1.917E-01, 1.800E+02 ) ( 1.917E-01, -1.800E+02 )
4 ( 7.306E-04, 0. ) ( 7.306E-04, 0. ) ( 2.119E-02, 0. ) ( 2.119E-02, 0. )
5 ( 1.888E-01, 1.800E+02 ) ( 1.888E-01, -1.800E+02 ) ( 3.889E-02, 0. ) ( 3.889E-02, 0. )
6 ( 1.259E+00, 0. ) ( 1.259E+00, 0. ) ( 3.656E-01, 1.800E+02 ) ( 3.656E-01, -1.800E+02 )
7 ( 1.092E+00, 1.800E+02 ) ( 1.092E+00, -1.800E+02 ) ( 3.247E+00, 1.800E+02 ) ( 3.247E+00, -1.800E+02 )

15
1 ( 3.617E-01, 1.800E+02 ) ( 3.617E-01, -1.800E+02 ) ( 6.793E-02, 0. ) ( 6.793E-02, 0. )
2 ( 4.167E-02, 1.800E+02 ) ( 4.167E-02, -1.800E+02 ) ( 2.040E-02, 0. ) ( 2.040E-02, 0. )
3 ( 2.778E-01, 0. ) ( 2.778E-01, 0. ) ( 1.917E-01, 1.800E+02 ) ( 1.917E-01, -1.800E+02 )
4 ( 7.306E-04, 0. ) ( 7.306E-04, 0. ) ( 2.119E-02, 0. ) ( 2.119E-02, 0. )
5 ( 1.888E-01, 1.800E+02 ) ( 1.888E-01, -1.800E+02 ) ( 3.889E-02, 0. ) ( 3.889E-02, 0. )
6 ( 1.259E+00, 0. ) ( 1.259E+00, 0. ) ( 3.656E-01, 1.800E+02 ) ( 3.656E-01, -1.800E+02 )
7 ( 1.092E+00, 1.800E+02 ) ( 1.092E+00, -1.800E+02 ) ( 3.247E+00, 1.800E+02 ) ( 3.247E+00, -1.800E+02 )

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** RESIDUE MATRICES **
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*** ROWS CORRESPOND TO MODES ***
*** COLUMNS CORRESPOND TO OUTPUTS ***
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IMPULSE RESIDUE MATRIX FOR CONTROL - 1

THE C-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(1.299E-03, -3.078E-04)	(-6.164E-05, -2.891E-04)	(6.651E-03, -6.495E-05)	(-1.008E-04, 5.393E-04)
2	(1.299E-03, 3.078E-04)	(-6.164E-05, 2.891E-04)	(6.651E-03, 6.495E-05)	(-1.008E-04, -5.393E-04)
3	(-1.271E-03, 3.019E-04)	(1.738E-04, 3.933E-04)	(-8.445E-03, 3.515E-03)	(1.630E-04, -1.867E-04)
4	(-1.271E-03, -3.019E-04)	(1.738E-04, -3.933E-04)	(-8.445E-03, -3.515E-03)	(1.630E-04, 1.867E-04)
5	(1.813E-10, -3.498E-09)	(-1.736E-09, 4.703E-10)	(-1.000E-08, -3.832E-08)	(-8.919E-10, 1.261E-09)
6	(1.813E-10, 3.498E-09)	(-1.736E-09, -4.703E-10)	(-1.000E-08, 3.832E-08)	(-8.919E-10, -1.261E-09)
7	(-1.144E+00, 9.415E-01)	(9.366E-02, 1.232E-01)	(-8.210E-01, 4.192E-01)	(4.064E-02, -2.525E-02)
8	(-1.144E+00, -9.415E-01)	(9.366E-02, -1.232E-01)	(-8.210E-01, -4.192E-01)	(4.064E-02, 2.525E-02)
9	(1.206E+00, 2.156E+00)	(6.915E-02, -1.905E-02)	(-2.566E-02, 1.189E-01)	(-7.992E-03, 3.662E-02)
10	(1.206E+00, -2.156E+00)	(6.915E-02, 1.905E-02)	(-2.566E-02, -1.189E-01)	(-7.992E-03, -3.662E-02)
11	(-1.694E+01, -3.205E-28)	(-2.702E-02, -5.112E-31)	(1.411E-03, 2.670E-32)	(-4.337E-02, -8.204E-31)
12	(1.903E+01, 2.590E-28)	(-4.404E-02, -5.994E-31)	(-3.195E-03, -4.343E-32)	(-2.651E-02, -3.608E-31)
13	(-2.211E+00, 0.)	(-2.546E-01, 0.)	(1.699E+00, 0.)	(4.467E-03, 0.)
14	(0.)	(0.)	(0.)	(0.)
15	(0.)	(0.)	(0.)	(0.)
	5	6	7	
1	(2.294E-03, -5.557E-04)	(1.986E-03, 5.307E-02)	(2.602E-01, 2.605E-01)	
2	(2.294E-03, 5.557E-04)	(1.986E-03, -5.307E-02)	(2.602E-01, -2.605E-01)	
3	(-2.254E-02, -8.334E-03)	(1.877E-01, -4.755E-01)	(-1.848E+00, -8.523E-01)	
4	(-2.254E-02, 8.334E-03)	(1.877E-01, 4.755E-01)	(-1.848E+00, 8.523E-01)	
5	(-1.620E-07, 1.276E-07)	(-2.776E-06, -3.594E-06)	(-6.473E-06, 4.782E-06)	
6	(-1.620E-07, -1.276E-07)	(-2.776E-06, 3.594E-06)	(-6.473E-06, -4.782E-06)	
7	(6.074E-01, 5.931E-01)	(-4.088E+00, 2.941E+00)	(4.592E+00, 6.154E+00)	
8	(6.074E-01, -5.931E-01)	(-4.088E+00, -2.941E+00)	(4.592E+00, -6.154E+00)	
9	(2.521E-02, -4.696E-02)	(5.077E-02, 7.472E-02)	(1.492E+00, 1.695E-01)	
10	(2.521E-02, 4.696E-02)	(5.077E-02, -7.472E-02)	(1.492E+00, -1.695E-01)	
11	(-3.645E-02, -6.901E-31)	(1.906E-03, 3.605E-32)	(6.670E-02, 1.562E-30)	
12	(-3.375E-02, -4.593E-31)	(-2.449E-03, -3.333E-32)	(-5.721E-02, -7.787E-31)	
13	(-1.154E+00, 0.)	(7.696E+00, 0.)	(-6.675E+00, 0.)	
14	(0.)	(0.)	(0.)	
15	(0.)	(0.)	(0.)	

CONTROL RESIDUE MATRIX (15 BY 7)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

1	(1.335E-03, -1.333E+01)	(2.956E-04, -1.020E+02)	(6.651E-03, -5.595E-01)	(5.486E-04, 1.006E+02)	4
2	(1.335E-03, 1.333E+01)	(2.956E-04, 1.020E+02)	(6.651E-03, 5.595E-01)	(5.486E-04, -1.006E+02)	
3	(1.306E-03, 1.666E+02)	(4.300E-04, 6.613E+01)	(9.147E-03, 1.574E+02)	(2.478E-04, -4.887E+01)	
4	(1.306E-03, -1.666E+02)	(4.300E-04, -6.613E+01)	(9.147E-03, -1.574E+02)	(2.478E-04, 4.887E+01)	
5	(3.502E-09, -8.703E+01)	(1.799E-09, 1.648E+02)	(3.960E-08, -1.046E+02)	(1.544E-09, 1.253E+02)	
6	(3.502E-09, 8.703E+01)	(1.799E-09, -1.648E+02)	(3.960E-08, 1.046E+02)	(1.544E-09, -1.253E+02)	
7	(1.482E+00, 1.406E+02)	(1.548E-01, 5.275E+01)	(9.219E-01, 1.530E+02)	(4.784E-02, -3.185E+01)	
8	(1.482E+00, -1.406E+02)	(1.548E-01, -5.275E+01)	(9.219E-01, -1.530E+02)	(4.784E-02, 3.185E+01)	
9	(2.471E+00, 6.077E+01)	(7.174E-02, -1.540E+01)	(1.216E-01, 1.022E+02)	(3.748E-02, -1.023E+02)	
10	(2.471E+00, -6.077E+01)	(7.174E-02, 1.540E+01)	(1.216E-01, -1.022E+02)	(3.748E-02, 1.023E+02)	
11	(1.694E+01, -1.800E+02)	(2.702E-02, -1.800E+02)	(1.411E-03, 1.084E-27)	(4.337E-02, -1.800E+02)	
12	(1.503E+01, 7.798E-28)	(4.404E-02, -1.800E+02)	(3.195E-03, -1.800E+02)	(2.651E-02, -1.800E+02)	
13	(2.211E+00, 1.800E+02)	(2.548E-01, 1.800E+02)	(1.699E+00, 0.)	(4.467E-03, 0.)	
14	(0.)	(0.)	(0.)	(0.)	
15	(0.)	(0.)	(0.)	(0.)	
1	(2.360E-03, -1.362E+01)	(5.311E-02, 8.786E+01)	(3.682E-01, 4.503E+01)		7
2	(2.360E-03, 1.362E+01)	(5.311E-02, -8.786E+01)	(3.682E-01, -4.503E+01)		
3	(2.403E-02, -1.597E+02)	(5.112E-01, -6.846E+01)	(2.035E+00, -1.552E+02)		
4	(2.403E-02, 1.597E+02)	(5.112E-01, 6.846E+01)	(2.035E+00, 1.552E+02)		
5	(2.062E-07, 1.418E+02)	(4.541E-06, -1.277E+02)	(8.048E-06, 1.435E+02)		
6	(2.062E-07, -1.418E+02)	(4.541E-06, 1.277E+02)	(8.048E-06, -1.435E+02)		
7	(8.454E-01, 4.407E+01)	(5.036E+00, 1.443E+02)	(7.678E+00, 5.327E+01)		
8	(8.454E-01, -4.407E+01)	(5.036E+00, -1.443E+02)	(7.678E+00, -5.327E+01)		
9	(5.330E-02, 6.178E+01)	(9.034E-02, 5.581E+01)	(1.502E+00, 6.479E+00)		
10	(5.330E-02, -6.178E+01)	(9.034E-02, -5.581E+01)	(1.502E+00, -6.479E+00)		
11	(3.646E-02, -1.800E+02)	(1.906E-03, 1.084E-27)	(6.670E-02, 1.084E-27)		
12	(3.375E-02, -1.800E+02)	(2.449E-03, -1.800E+02)	(5.722E-02, -1.800E+02)		
13	(1.154E+00, 1.800E+02)	(7.696E+00, 0.)	(6.675E+00, 1.800E+02)		
14	(0.)	(0.)	(0.)		
15	(0.)	(0.)	(0.)		

THE D-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(-6.676E-05, -4.102E-05)	(-9.414E-06, 1.457E-05)	(-2.792E-04, -2.729E-04)	(2.654E-05, -1.825E-05)
2	(-6.676E-05, 4.102E-05)	(-9.414E-06, -1.457E-05)	(-2.792E-04, 2.729E-04)	(2.654E-05, 1.825E-05)
3	(-1.478E-05, 1.638E-06)	(1.415E-06, 4.686E-06)	(-1.003E-04, 2.793E-05)	(2.102E-06, -1.882E-06)
4	(-1.478E-05, -1.638E-06)	(1.415E-06, -4.686E-06)	(-1.003E-04, -2.793E-05)	(2.102E-06, 1.882E-06)
5	(3.893E-09, 1.120E-09)	(-7.543E-11, -2.078E-09)	(4.578E-08, -1.237E-09)	(-1.187E-09, -1.335E-09)
6	(3.893E-09, -1.120E-09)	(-7.543E-11, 2.078E-09)	(4.578E-08, 1.237E-09)	(-1.187E-09, 1.335E-09)
7	(-1.878E-03, 2.841E-05)	(-4.567E-06, 1.961E-04)	(-1.145E-03, -2.335E-04)	(6.022E-05, 7.102E-06)
8	(-1.878E-03, -2.841E-05)	(-4.567E-06, -1.961E-04)	(-1.145E-03, 2.335E-04)	(6.022E-05, -7.102E-06)
9	(-6.393E-03, 4.926E-03)	(9.451E-05, 2.144E-04)	(-3.963E-04, -2.630E-05)	(1.145E-04, -4.327E-05)
10	(-6.393E-03, -4.926E-03)	(9.451E-05, -2.144E-04)	(-3.963E-04, 2.630E-05)	(1.145E-04, 4.327E-05)
11	(6.677E-03, 5.295E-28)	(1.065E-05, 8.444E-31)	(-5.562E-07, -4.411E-32)	(1.705E-05, 1.355E-30)
12	(9.032E-03, -6.747E-28)	(-2.090E-05, 1.561E-30)	(-1.517E-06, 1.133E-31)	(-1.258E-05, 9.399E-31)
13	(0, 0)	(0, 0)	(0, 0)	(0, 0)
14	(-7.839E-02, 0)	(-2.399E-02, 0)	(2.279E-01, 0)	(-2.518E-02, 0)
15	(7.939E-02, 0)	(2.394E-02, 0)	(-2.241E-01, 0)	(2.477E-02, 0)
	5	6	7	
1	(-1.184E-04, -7.193E-05)	(2.117E-03, -2.289E-03)	(-2.543E-05, -2.161E-02)	
2	(-1.184E-04, 7.193E-05)	(2.117E-03, 2.289E-03)	(-2.543E-05, 2.161E-02)	
3	(-2.430E-04, -1.256E-04)	(2.784E-03, -5.111E-03)	(-1.969E-02, -1.221E-02)	
4	(-2.430E-04, 1.256E-04)	(2.784E-03, 5.111E-03)	(-1.969E-02, 1.221E-02)	
5	(-1.013E-07, -2.155E-07)	(4.775E-06, -2.186E-06)	(-3.692E-06, -8.544E-06)	
6	(-1.013E-07, 2.155E-07)	(4.775E-06, 2.186E-06)	(-3.692E-06, 8.544E-06)	
7	(1.370E-04, 1.063E-03)	(-6.375E-03, -3.175E-04)	(-3.136E-04, 9.726E-03)	
8	(1.370E-04, -1.063E-03)	(-6.375E-03, 3.175E-04)	(-3.136E-04, -9.726E-03)	
9	(1.639E-04, 5.909E-05)	(-2.173E-04, 1.597E-04)	(1.630E-04, 4.902E-03)	
10	(1.639E-04, -5.909E-05)	(-2.173E-04, -1.597E-04)	(1.630E-04, -4.902E-03)	
11	(1.438E-05, 1.140E-30)	(-7.510E-07, -5.955E-32)	(-2.628E-05, -2.084E-30)	
12	(-1.602E-05, 1.197E-30)	(-1.162E-06, 8.681E-32)	(-2.716E-05, 2.029E-30)	
13	(0, 0)	(0, 0)	(0, 0)	
14	(-4.533E-02, 0)	(4.306E-01, 0)	(3.886E+00, 0)	
15	(4.545E-02, 0)	(-4.273E-01, 0)	(-3.794E+00, 0)	

DISTURBANCE RESIDUE MATRIX (15 BY 7)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

ORIGINAL PAGE IS
OF POOR QUALITY

1	(7.835E-05, -1.484E+02)	1	(1.735E-05, 1.229E+02)	3	(3.904E-04, -1.357E+02)	4	(3.220E-05, -3.451E+01)
2	(7.835E-05, 1.484E+02)	2	(1.735E-05, -1.229E+02)		(3.904E-04, 1.357E+02)		(3.220E-05, 3.451E+01)
3	(1.487E-05, 1.737E+02)		(4.895E-06, 7.320E+01)		(1.041E-04, 1.644E+02)		(2.821E-06, -4.183E+01)
4	(1.487E-05, -1.737E+02)		(4.895E-06, -7.320E+01)		(1.041E-04, -1.644E+02)		(2.821E-06, 4.183E+01)
5	(4.051E-09, 1.605E+01)		(2.080E-09, 9.208E+01)		(4.580E-08, -1.545E+00)		(1.786E-09, -1.316E+02)
6	(4.051E-09, -1.605E+01)		(2.080E-09, -9.208E+01)		(4.580E-08, 1.545E+00)		(1.786E-09, 1.316E+02)
7	(1.878E-03, 1.791E+02)		(1.961E-04, 9.133E+01)		(1.168E-03, -1.685E+02)		(6.063E-05, 6.727E+00)
8	(1.878E-03, -1.791E+02)		(1.961E-04, -9.133E+01)		(1.168E-03, 1.685E+02)		(6.063E-05, -6.727E+00)
9	(8.071E-03, 1.424E+02)		(2.343E-04, 6.621E+01)		(3.972E-04, -1.762E+02)		(1.224E-04, -2.069E+01)
10	(8.071E-03, -1.424E+02)		(2.343E-04, -6.621E+01)		(3.972E-04, 1.762E+02)		(1.224E-04, 2.069E+01)
11	(6.677E-03, 4.543E-24)		(1.065E-05, 4.543E-24)		(5.562E-07, -1.800E+02)		(1.709E-05, 4.543E-24)
12	(6.677E-03, -4.543E-24)		(1.065E-05, -4.543E-24)		(5.562E-07, 1.800E+02)		(1.709E-05, -4.543E-24)
13	(0.000E+00, 0.000E+00)		(0.000E+00, 0.000E+00)		(0.000E+00, 0.000E+00)		(0.000E+00, 0.000E+00)
14	(7.839E-02, 1.800E+02)		(2.399E-02, 1.800E+02)		(2.279E-01, 0.000E+00)		(2.518E-02, 1.800E+02)
15	(7.839E-02, 0.000E+00)		(2.399E-02, 0.000E+00)		(2.279E-01, 0.000E+00)		(2.518E-02, 0.000E+00)
1	(1.385E-04, -1.487E+02)	5	(3.118E-03, -4.724E+01)	7	(2.161E-02, -9.007E+01)		
2	(1.385E-04, 1.487E+02)		(3.118E-03, 4.724E+01)		(2.161E-02, 9.007E+01)		
3	(2.736E-04, -1.527E+02)		(5.820E-03, -6.142E+01)		(2.317E-02, -1.482E+02)		
4	(2.736E-04, 1.527E+02)		(5.820E-03, 6.142E+01)		(2.317E-02, 1.482E+02)		
5	(2.385E-07, -1.151E+02)		(5.252E-06, -2.460E+01)		(9.307E-06, -1.134E+02)		
6	(2.385E-07, 1.151E+02)		(5.252E-06, 2.460E+01)		(9.307E-06, 1.134E+02)		
7	(1.071E-03, 8.265E+01)		(6.383E-03, -1.771E+02)		(9.731E-03, 9.185E+01)		
8	(1.071E-03, -8.265E+01)		(6.383E-03, 1.771E+02)		(9.731E-03, -9.185E+01)		
9	(1.741E-04, 1.984E+01)		(2.951E-04, 1.374E+02)		(4.905E-03, 8.810E+01)		
10	(1.741E-04, -1.984E+01)		(2.951E-04, -1.374E+02)		(4.905E-03, -8.810E+01)		
11	(1.438E-05, 4.543E-24)		(7.510E-07, -1.800E+02)		(2.628E-05, -1.800E+02)		
12	(1.438E-05, -4.543E-24)		(7.510E-07, 1.800E+02)		(2.628E-05, 1.800E+02)		
13	(0.000E+00, 0.000E+00)		(0.000E+00, 0.000E+00)		(0.000E+00, 0.000E+00)		
14	(4.533E-02, 1.800E+02)		(4.306E-01, 0.000E+00)		(3.886E+00, 0.000E+00)		
15	(4.533E-02, 0.000E+00)		(4.306E-01, 0.000E+00)		(3.886E+00, 0.000E+00)		

CONFIGURATION 4

THE AU MATRIX (12 BY 12)											
1	-1.208E+00	9.440E-01	-6.340E-04	0.	-8.940E-03	9.525E-02					
2	-7.055E+00	-2.018E+00	-2.250E-03	0.	-1.842E-01	-1.248E-01					
3	-2.500E+01	0.	-2.500E-02	-3.220E+01	0.	0.					
4	0.	1.000E+00	0.	0.	0.	0.					
5	0.	0.	0.	0.	0.	0.					
6	0.	0.	0.	0.	0.	0.					
7	0.	0.	0.	0.	0.	0.					
8	0.	0.	0.	0.	0.	0.					
9	-7.383E+02	-1.333E+02	-1.435E-03	0.	-1.774E+02	-1.568E+01					
10	1.300E+03	1.633E+01	0.	0.	1.407E+01	-5.061E+02					
11	7.577E+02	5.595E+01	-3.900E-03	0.	6.990E+00	3.458E+01					
12	1.688E+00	3.990E-02	0.	0.	1.623E-02	-9.700E-02					
1	4.618E-03	-4.346E-03	-2.130E-04	2.590E-03	1.526E-04	-4.998E-06					
2	2.072E-01	-9.171E-02	-7.438E-03	4.972E-02	6.963E-03	-2.004E-03					
3	0.	0.	0.	0.	0.	0.					
4	0.	0.	0.	0.	0.	0.					
5	0.	0.	1.000E+00	0.	0.	0.					
6	0.	0.	0.	0.	0.	0.					
7	0.	0.	0.	0.	0.	0.					
8	0.	0.	0.	0.	1.000E+00	0.					
9	-1.540E+01	2.088E+01	-1.139E+00	-2.770E-01	9.159E-01	-1.977E-01					
10	6.593E+00	1.124E+01	2.351E-01	-8.596E+00	1.131E-01	1.120E-01					
11	-2.085E+01	3.457E+00	-1.219E-01	3.784E+00	-1.929E-01	-2.535E-01					
12	7.112E-03	-4.849E+02	-3.290E-04	2.427E-03	-2.764E-04	-4.020E-01					

THE AC MATRIX (2 BY 2)	
1	-9.400E+00
2	-2.256E-02

THE D MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	-7.371E+02
10	0.	1.298E+03
11	0.	7.564E+02
12	0.	1.697E+00

THE E VECTOR (7 BY 1)

1
1
2
3
4
5
6
7

THE F MATRIX (7 BY 2)

	1	2
1	0.	0.
2	0.	0.
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	9.243E+00

THE GC VECTOR (15 BY 1)

1
 0.
 2 1.000E+00
 3 5.621E-03
 4 0.
 5 0.
 6 0.
 7 0.
 8 0.
 9 0.
 10 0.
 11 0.
 12 0.
 13 0.
 14 0.
 15 0.

AP = -6.667E+00

THE GP VECTOR (15 BY 1)

1
 1.000E+00
 2 0.
 3 0.
 4 0.
 5 0.
 6 0.
 7 0.
 8 0.
 9 0.
 10 0.
 11 0.
 12 0.
 13 0.
 14 0.
 15 0.

THE AU-SCALED MATRIX (12 BY 12)

	1	2	3	4	5	6
1	-1.208E+00	9.440E-01	-6.017E-01	0.	3.386E-01	-2.886E+00
2	-7.059E+00	-2.018E+00	-2.173E+00	0.	6.977E+00	3.782E+00
3	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.	0.
4	0.	1.000E+00	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	1.949E+01	3.519E+00	3.595E-02	0.	-1.774E+02	-1.254E+01
10	-4.290E+01	-5.389E-01	0.	0.	1.759E+01	-5.061E+02
11	-2.619E+01	-1.934E+00	1.279E-01	0.	9.151E+00	3.621E+01
12	-6.138E-02	-1.451E-03	0.	0.	2.235E-02	-1.059E-01

	7	8	9	10	11	12
1	-1.336E-01	1.195E-01	8.068E-03	-7.848E-02	-4.416E-03	1.375E-04
2	-5.995E+00	2.522E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	1.000E+00	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.	0.
7	0.	0.	0.	0.	1.000E+00	0.
8	0.	0.	0.	0.	0.	1.000E+00
9	-1.176E+01	1.516E+01	-1.139E+00	-2.216E-01	6.996E-01	-1.435E-01
10	6.295E+00	1.020E+01	2.939E-01	-8.596E+00	1.020E-01	1.017E-01
11	-3.085E+01	3.286E+00	-1.596E-01	3.963E+00	-1.929E-01	-2.410E-01
12	7.482E-03	-4.849E+02	-4.531E-04	2.674E-03	-2.908E-04	-4.080E-01

THE B-SCALED VECTOR (12 BY 1)

	1
1	-2.884E-01
2	-1.503E+01
3	0.
4	0.
5	0.
6	0.
7	0.
8	0.
9	5.886E+01
10	7.103E+00
11	-2.120E+01
12	-3.921E-03

 THE C-SCALED MATRIX (7 BY 12)

	1	2	3	4	5	6
1	0.	0.	9.490E+02	0.	0.	0.
2	0.	0.	0.	1.000E+00	0.	0.
3	0.	1.000E+00	0.	0.	0.	0.
4	-1.000E+00	0.	0.	1.000E+00	0.	0.
5	0.	0.	0.	1.000E+00	-1.000E+00	-1.000E+00
6	0.	1.000E+00	0.	0.	0.	0.
7	9.322E+00	-1.395E+00	1.350E+01	0.	-6.103E+01	-9.740E+01

	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	-1.000E+00	-1.000E+00	0.	0.	0.	0.
6	0.	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-1.533E+01	-4.599E+01	-6.597E-02	-3.342E+00	3.012E-02	-3.964E-03

 THE D-SCALED MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	1.946E+01
10	0.	-4.283E+01
11	0.	-2.614E+01
12	0.	-6.170E-02

THE AA MATRIX (15 BY 15)

1	2	3	4	5	6	7	8
-6.667E+00	0.	0.	0.	0.	0.	0.	0.
0.	-9.400E+00	0.	0.	0.	0.	0.	0.
0.	-2.256E-02	-9.500E+00	0.	0.	0.	0.	0.
-2.884E-01	0.	-1.204E+00	-1.208E+00	9.440E-01	-6.017E-01	0.	3.386E-01
-1.503E+01	0.	-7.049E+00	-7.059E+00	-2.018E+00	-2.173E+00	0.	6.977E+00
0.	0.	0.	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.
0.	0.	0.	0.	1.000E+00	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
5.886E+01	0.	1.946E+01	1.949E+01	3.519E+00	3.595E-02	0.	-1.774E+02
7.103E+00	0.	-4.283E+01	-4.290E+01	-5.389E-01	0.	0.	1.759E+01
-2.120E+01	0.	-2.614E+01	-2.619E+01	-1.934E+00	1.279E-01	0.	9.151E+00
-3.921E-03	0.	-6.170E-02	-6.136E-02	-1.451E-03	0.	0.	2.235E-02
9	10	11	12	13	14	15	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
-2.886E+00	-1.336E-01	1.195E-01	8.068E-03	-7.848E-02	-4.416E-03	1.375E-04	
3.782E+00	-5.995E+00	2.522E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	1.000E+00	0.	0.	0.	
0.	0.	0.	0.	1.000E+00	0.	0.	
0.	0.	0.	0.	0.	1.000E+00	0.	
0.	0.	0.	0.	0.	0.	1.000E+00	
-1.254E+01	-1.176E+01	1.516E+01	-1.139E+00	-2.216E-01	6.996E-01	-1.435E-01	
-5.061E+02	5.295E+00	1.020E+01	2.939E-01	-8.596E+00	1.080E-01	1.017E-01	
3.621E+01	-3.085E+01	3.286E+00	-1.596E-01	3.963E+00	-1.529E-01	-2.410E-01	
-1.069E-01	7.482E-03	-4.649E+02	-4.531E-04	2.674E-03	-2.908E-04	-4.080E-01	

THE CC MATRIX (7 BY 15)

	1	2	3	4	5
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	1.000E+00
4	0.	0.	-1.000E+00	0.	0.
5	0.	0.	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.
7	2.327E+00	0.	9.243E+00	9.322E+00	-1.395E+00
	6	7	8	9	10
1	9.490E+02	0.	0.	0.	0.
2	0.	1.000E+00	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	1.000E+00	0.	0.	0.
5	0.	1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
6	0.	0.	0.	0.	0.
7	1.350E+01	0.	-6.103E+01	-9.740E+01	-1.533E+01
	11	12	13	14	15
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.
5	-1.000E+00	0.	0.	0.	0.
6	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-4.599E+01	-6.597E+02	-3.342E+00	3.012E-02	-3.964E-03

SPECTRAL DECOMPOSITION OF A-AUG

	REAL PART	IMAGINARY PART	FREQUENCY (HERTZ)	DAMPING RATIO	TIME CONST. (SEC/RAD)
1	-4.50431E+00	2.19936E+01	3.57305E+00	.20063594	2.22010E-01
3	-2.03841E-01	2.20195E+01	3.50468E+00	.00925690	4.90578E+00
5	-6.98715E-01	1.32793E+01	2.11628E+00	.05254431	1.43120E+00
7	-5.64212E-01	5.93400E+00	3.48685E-01	.39465439	1.77238E+00
9	-8.40533E-01	1.04297E+00	2.13130E-01	.62749222	1.18972E+00
11	1.62694E-01	0.	0.	-1.00000000	-6.14649E+00
12	-1.26380E-01	0.	0.	1.00000000	7.91264E+00
13	-6.66667E+00	0.	0.	1.00000000	1.50000E-01
14	-9.50000E+00	0.	0.	1.00000000	1.05263E-01
15	-9.40000E+00	0.	0.	.00000000	1.06383E-01


```

14 (-3.603E-01, 3.904E-01) (-3.603E-01, -3.904E-01) (-4.240E-02, 0. )
15 (-3.977E-03, 5.235E-05) (-3.977E-05, -5.235E-05) (-5.172E-06, 0. )

13
1 ( 2.966E-01, 0. )
2 ( 0. , 0. )
3 ( 0. , 0. )
4 (-9.308E-02, 0. )
5 ( 6.311E-01, 0. )
6 (-8.528E-04, 0. )
7 (-9.465E-02, 0. )
8 ( 8.746E-02, 0. )
9 ( 1.385E-02, 0. )
10 (-5.522E-02, 0. )
11 ( 6.831E-06, 0. )
12 (-5.831E-01, 0. )
13 (-9.233E-02, 0. )
14 ( 3.651E-01, 0. )
15 (-4.554E-05, 0. )

14
1 ( 0. , 0. )
2 ( 8.373E-01, 0. )
3 (-1.885E-01, 0. )
4 (-1.245E-03, 0. )
5 (-1.839E-01, 0. )
6 ( 6.731E-05, 0. )
7 ( 1.556E-02, 0. )
8 (-2.081E-02, 0. )
9 ( 1.589E-02, 0. )
10 ( 4.334E-02, 0. )
11 ( 1.719E-05, 0. )
12 ( 1.956E-01, 0. )
13 (-1.495E-01, 0. )
14 (-4.074E-01, 0. )
15 (-1.616E-04, 0. )

15
1 (-4.004E-02, 0. )
2 (-4.927E-06, 0. )

```

THE CON VECTOR (15 BY 1)

```

1
2 (-6.507E-02, 2.179E-02)
3 (-9.092E-05, -1.319E-04)
4 (-9.092E-05, 1.319E-04)
5 (-6.201E-01, -1.858E+00)
6 (-6.201E-01, 1.858E+00)
7 (-6.203E-01, 1.314E+00)
8 (-6.203E-01, -1.314E+00)
9 (-2.678E-01, -1.423E+00)
10 (-2.678E-01, 1.423E+00)
11 (-3.411E-01, 3.876E-30)
12 (-2.469E-01, -2.076E-30)
13 ( 3.349E+00, 0. )
14 ( 0. , 0. )
15 ( 0. , 0. )

```

CONTROLABILITY MATRIX (15 BY 1)
OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1
2 ( 6.362E-02, 1.615E+02)
3 ( 6.362E-02, -1.615E+02)
4 ( 1.602E-04, -1.246E+02)
5 ( 1.602E-04, 1.246E+02)
6 ( 2.031E+00, -1.133E+02)
7 ( 2.031E+00, 1.133E+02)
8 ( 1.533E+00, 1.153E+02)
9 ( 1.533E+00, -1.153E+02)
10 ( 1.446E+00, -1.007E+02)
11 ( 1.446E+00, 1.007E+02)
12 ( 3.411E-01, 1.800E+02)
13 ( 2.469E-01, -1.800E+02)
14 ( 3.345E+00, 0. )
15 ( 0. , 0. )

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ORIGINAL PAGE IS
OF POOR QUALITY

THE DIST VECTOR (15 BY 1)

```

1 ( 5.520E-03, 1.183E-03 )
2 ( 5.520E-03, -1.183E-03 )
3 ( 1.013E-07, -8.532E-06 )
4 ( 1.013E-07, 8.532E-06 )
5 ( 4.532E-04, -3.104E-03 )
6 ( 4.532E-04, 3.104E-03 )
7 ( -4.629E-03, 3.641E-03 )
8 ( -4.629E-03, -3.641E-03 )
9 ( 4.351E-06, -5.262E-04 )
10 ( 4.351E-06, 5.262E-04 )
11 ( -3.047E-05, 4.734E-30 )
12 ( 3.191E-05, 1.571E-30 )
13 ( 0, 0 )
14 ( 6.672E-01, 0 )
15 ( 1.194E+00, 0 )

```

DISTURBABILITY MATRIX (15 BY 1)
OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1 ( 5.645E-03, 1.210E+01 )
2 ( 5.645E-03, -1.210E+01 )
3 ( 8.533E-06, -8.932E+01 )
4 ( 8.533E-06, 8.932E+01 )
5 ( 3.137E-03, -8.169E+01 )
6 ( 3.137E-03, 8.169E+01 )
7 ( 5.890E-03, 1.418E+02 )
8 ( 5.890E-03, -1.418E+02 )
9 ( 5.262E-04, -8.953E+01 )
10 ( 5.262E-04, 8.953E+01 )
11 ( 3.047E-05, 1.800E+02 )
12 ( 3.191E-05, 2.820E-24 )
13 ( 0, 0 )
14 ( 6.672E-01, 0 )
15 ( 1.194E+00, 0 )

```

ORIGINAL PAGE IS
OF POOR QUALITY

THE OBS MATRIX (7 BY 15)

1	(-1.357E-02, -3.490E-03)	(-1.357E-02, 3.490E-03)	(-4.228E-05, -6.641E-05)	(-4.228E-05, 6.641E-05)
2	(-7.347E-04, 2.984E-03)	(-7.347E-04, -2.984E-03)	(6.773E-05, -1.925E-05)	(6.773E-05, 1.925E-05)
3	(-6.233E-02, -2.960E-02)	(-6.233E-02, 2.960E-02)	(4.101E-04, 1.495E-03)	(4.101E-04, -1.495E-03)
4	(3.821E-03, -4.486E-03)	(3.821E-03, 4.486E-03)	(2.137E-04, -8.082E-05)	(2.137E-04, 8.082E-05)
5	(-4.153E-02, 5.445E-04)	(-4.153E-02, -5.445E-04)	(3.402E-02, -2.651E-02)	(3.402E-02, 2.651E-02)
6	(1.751E-01, -9.159E-01)	(1.751E-01, 9.159E-01)	(5.767E-01, 7.545E-01)	(5.767E-01, -7.545E-01)
7	(-2.785E+00, -2.699E+00)	(-2.789E+00, 3.699E+00)	(1.673E+00, -1.38E+00)	(1.673E+00, 1.383E+00)
1	(-1.337E-03, -1.510E-02)	(-1.337E-03, 1.510E-02)	(2.223E-01, 2.576E-01)	(2.223E-01, -2.576E-01)
2	(-3.436E-03, 7.254E-04)	(-3.436E-03, -7.254E-04)	(2.608E-02, -2.428E-02)	(2.608E-02, 2.428E-02)
3	(-7.232E-03, -4.613E-02)	(-7.232E-03, 4.613E-02)	(1.294E-01, 1.684E-01)	(1.294E-01, -1.684E-01)
4	(1.975E-04, 1.357E-03)	(1.975E-04, -1.357E-03)	(-6.281E-03, 8.357E-03)	(-6.281E-03, -8.357E-03)
5	(-6.131E-02, 4.487E-02)	(-6.131E-02, -4.487E-02)	(-4.905E-02, 1.030E-01)	(-4.905E-02, -1.030E-01)
6	(-5.530E-01, -8.455E-01)	(-5.530E-01, 8.455E-01)	(-5.837E-01, -3.492E-01)	(-5.837E-01, 3.492E-01)
7	(-4.059E+00, 2.762E+00)	(-4.059E+00, -2.762E+00)	(-1.119E+00, 8.516E-01)	(-1.119E+00, -8.516E-01)
1	(-1.389E+01, -7.920E+00)	(-1.389E+01, 7.920E+00)	(-1.895E+02, 0.)	(-1.895E+02, 0.)
2	(-2.654E-01, 2.270E-01)	(-2.654E-01, -2.270E-01)	(8.879E-01, 0.)	(8.879E-01, 0.)
3	(-1.030E-02, -4.717E-01)	(-1.030E-02, 4.717E-01)	(1.445E-01, 0.)	(1.445E-01, 0.)
4	(1.673E-01, 1.930E-01)	(1.673E-01, -1.930E-01)	(6.091E-01, 0.)	(6.091E-01, 0.)
5	(-6.256E-01, 2.094E-01)	(-6.256E-01, -2.094E-01)	(1.121E+00, 0.)	(1.121E+00, 0.)
6	(3.074E-01, -9.285E-01)	(3.074E-01, 9.285E-01)	(1.824E-01, 0.)	(1.824E-01, 0.)
7	(-9.271E+00, 9.170E-01)	(-9.271E+00, -9.170E-01)	(2.969E+00, 0.)	(2.969E+00, 0.)
1	(-8.093E-01, 0.)	(-1.130E-01, 0.)	(6.388E-02, 0.)	(6.388E-02, 0.)
2	(-9.465E-02, 0.)	(-3.526E-02, 0.)	(1.956E-02, 0.)	(1.956E-02, 0.)
3	(6.311E-01, 0.)	(2.350E-01, 0.)	(-1.835E-01, 0.)	(-1.835E-01, 0.)
4	(-1.589E-03, 0.)	(-3.786E-02, 0.)	(2.081E-02, 0.)	(2.081E-02, 0.)
5	(-1.408E-01, 0.)	(3.429E-02, 0.)	(-1.856E-02, 0.)	(-1.856E-02, 0.)
6	(9.385E-01, 0.)	(-3.258E-01, 0.)	(1.774E-01, 0.)	(1.774E-01, 0.)
7	(-6.547E+00, 0.)	(3.608E+00, 0.)	(-1.525E+00, 0.)	(-1.525E+00, 0.)

OBSERVABILITY MATRIX (7 BY 15)
OUTPUT FORM: (MAGNITUDE , PHASE (DEG.))

ORIGINAL PAGE IS
OF POOR QUALITY

1	(1.401E-02, -1.656E+02)	(1.401E-02, 1.656E+02)	(7.873E-05, -1.225E+02)	(7.873E-05, 1.225E+02)	4
2	(3.074E-03, 1.038E+02)	(3.074E-03, -1.038E+02)	(7.041E-05, -1.587E+01)	(7.041E-05, 1.587E+01)	
3	(6.900E-02, -1.546E+02)	(6.900E-02, 1.546E+02)	(1.550E-03, 7.466E+01)	(1.550E-03, -7.466E+01)	
4	(5.833E-03, -4.958E+01)	(5.833E-03, 4.958E+01)	(2.285E-04, -2.071E+01)	(2.285E-04, 2.071E+01)	
5	(4.154E-02, 1.792E+02)	(4.154E-02, -1.792E+02)	(4.313E-02, -3.792E+01)	(4.313E-02, 3.792E+01)	
6	(9.325E-01, -7.918E+01)	(9.325E-01, 7.918E+01)	(9.497E-01, 5.261E+01)	(9.497E-01, -5.261E+01)	
7	(4.633E+00, -1.270E+02)	(4.633E+00, 1.270E+02)	(2.170E+00, -3.957E+01)	(2.170E+00, 3.957E+01)	
1	(1.516E-02, -9.506E+01)	(1.516E-02, 9.506E+01)	(3.403E-01, 4.921E+01)	(3.403E-01, -4.921E+01)	8
2	(3.512E-03, 1.681E+02)	(3.512E-03, -1.681E+02)	(3.563E-02, -4.236E+01)	(3.563E-02, 4.236E+01)	
3	(4.670E-02, -9.891E+01)	(4.670E-02, 9.891E+01)	(2.124E-01, 5.247E+01)	(2.124E-01, -5.247E+01)	
4	(1.371E-03, 3.171E+01)	(1.371E-03, -3.171E+01)	(1.045E-02, -1.269E+02)	(1.045E-02, 1.269E+02)	
5	(7.597E-02, 1.438E+02)	(7.597E-02, -1.438E+02)	(1.141E-01, 1.155E+02)	(1.141E-01, -1.155E+02)	
6	(1.010E+00, -1.232E+02)	(1.010E+00, 1.232E+02)	(6.802E-01, -1.491E+02)	(6.802E-01, 1.491E+02)	
7	(4.910E+00, 1.458E+02)	(4.910E+00, -1.458E+02)	(1.406E+00, 1.427E+02)	(1.406E+00, -1.427E+02)	
1	(1.599E+01, -1.503E+02)	(1.599E+01, 1.503E+02)	(1.895E+02, 1.800E+02)	(1.895E+02, 0.)	12
2	(3.522E-01, 1.395E+02)	(3.522E-01, -1.395E+02)	(8.879E-01, 0.)	(8.879E-01, 0.)	
3	(4.718E-01, -9.125E+01)	(4.718E-01, 9.125E+01)	(1.445E-01, 0.)	(1.445E-01, 1.800E+02)	
4	(2.592E-01, 4.980E+01)	(2.592E-01, -4.980E+01)	(6.091E-01, 0.)	(6.091E-01, 0.)	
5	(6.597E-01, 1.615E+02)	(6.597E-01, -1.615E+02)	(1.121E+00, 0.)	(1.121E+00, 0.)	
6	(8.837E-01, -6.564E+01)	(8.837E-01, 6.564E+01)	(1.824E-01, 0.)	(1.824E-01, 1.800E+02)	
7	(9.317E+00, 1.744E+02)	(9.317E+00, -1.744E+02)	(2.969E+00, 0.)	(2.969E+00, 1.800E+02)	
1	(8.093E-01, 1.800E+02)	(1.130E-01, 1.800E+02)	(6.388E-02, 0.)	(6.388E-02, 0.)	15
2	(9.466E-02, 1.800E+02)	(3.526E-02, 1.800E+02)	(1.956E-02, 0.)	(1.956E-02, 0.)	
3	(6.311E-01, 0.)	(3.350E-01, 0.)	(1.859E-01, 1.800E+02)	(1.859E-01, 1.800E+02)	
4	(1.589E-03, 1.800E+02)	(3.786E-02, 1.800E+02)	(2.081E-02, 0.)	(2.081E-02, 0.)	
5	(1.408E-01, 1.800E+02)	(3.429E-02, 0.)	(1.888E-02, 1.800E+02)	(1.888E-02, 1.800E+02)	
6	(9.385E-01, 0.)	(3.258E-01, 1.800E+02)	(1.774E-01, 0.)	(1.774E-01, 0.)	
7	(6.547E+00, 1.800E+02)	(3.608E+00, 0.)	(1.965E+00, 1.800E+02)	(1.965E+00, 1.800E+02)	

** RESIDUE MATRICES **

*** ROWS CORRESPOND TO MODES ***
*** COLUMNS CORRESPOND TO OUTPUTS ***

IMPULSE RESIDUE MATRIX FOR CONTROL - 1

 THE C-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(9.592E-04, -6.867E-05)	(-1.722E-05, -2.102E-04)	(4.701E-03, 5.680E-04)	(-1.509E-04, 3.752E-04)
2	(9.592E-04, 6.867E-05)	(-1.722E-05, 2.102E-04)	(4.701E-03, -5.680E-04)	(-1.509E-04, -3.752E-04)
3	(-4.918E-09, 1.162E-08)	(-8.698E-09, -7.186E-09)	(1.600E-07, -1.901E-07)	(-3.010E-08, -2.086E-08)
4	(-4.918E-09, -1.162E-08)	(-8.698E-09, 7.186E-09)	(1.600E-07, 1.901E-07)	(-3.010E-08, 2.086E-08)
5	(-2.696E-02, 1.487E-02)	(4.165E-03, 5.788E-03)	(-7.977E-02, 5.127E-02)	(2.358E-03, -1.480E-03)
6	(-2.696E-02, -1.487E-02)	(4.165E-03, -5.788E-03)	(-7.977E-02, -5.127E-02)	(2.358E-03, 1.480E-03)
7	(-4.765E-01, 1.323E-01)	(1.574E-02, 4.933E-02)	(-3.016E-01, 6.556E-02)	(1.428E-02, -3.070E-03)
8	(-4.765E-01, -1.323E-01)	(1.574E-02, -4.933E-02)	(-3.016E-01, -6.556E-02)	(1.428E-02, 3.070E-03)
9	(-7.552E+00, 2.189E+01)	(3.951E-01, 3.226E-01)	(-6.686E-01, 1.410E-01)	(2.370E-01, -2.912E-01)
10	(-7.552E+00, -2.189E+01)	(3.951E-01, -3.226E-01)	(-6.686E-01, -1.410E-01)	(2.370E-01, 2.912E-01)
11	(6.453E+01, -2.343E-28)	(-3.029E-01, 3.441E-30)	(-4.928E-02, 5.599E-31)	(-2.078E-01, 2.361E-30)
12	(-4.581E+01, -3.856E-28)	(-2.102E-01, -1.769E-30)	(2.656E-02, 2.236E-31)	(-2.951E-01, -2.484E-30)
13	(-2.710E+00, 0.)	(-3.170E-01, 0.)	(2.113E+00, 0.)	(-5.319E-03, 0.)
14	(0.)	(0.)	(0.)	(0.)
15	(0.)	(0.)	(0.)	(0.)
	5	6	7	
1	(2.691E-03, -9.405E-04)	(8.565E-03, 6.342E-02)	(2.621E-01, 1.799E-01)	
2	(2.691E-03, 9.405E-04)	(8.565E-03, -6.342E-02)	(2.621E-01, -1.799E-01)	
3	(-6.590E-06, -2.079E-06)	(4.712E-05, -1.447E-04)	(-3.346E-04, -3.502E-05)	
4	(-6.590E-06, 2.079E-06)	(4.712E-05, 1.447E-04)	(-3.346E-04, 3.502E-05)	
5	(1.336E-01, 7.709E-02)	(-1.117E+00, 1.721E+00)	(8.461E+00, 5.275E+00)	
6	(1.336E-01, -7.709E-02)	(-1.117E+00, -1.721E+00)	(8.461E+00, -5.275E+00)	
7	(-1.050E-01, -1.284E-01)	(8.210E-01, -5.505E-01)	(-4.249E-01, -1.995E+00)	
8	(-1.050E-01, 1.284E-01)	(8.210E-01, 5.505E-01)	(-4.249E-01, 1.995E+00)	
9	(4.656E-01, 8.343E-01)	(-1.262E+00, -2.157E-01)	(3.788E+00, 1.295E+01)	
10	(4.656E-01, -8.343E-01)	(-1.262E+00, 2.157E-01)	(3.788E+00, -1.295E+01)	
11	(-3.825E-01, 4.346E-30)	(-6.223E-02, 7.071E-31)	(-1.013E+00, 1.151E-29)	
12	(-1.295E-01, -1.178E-29)	(1.768E-02, 1.488E-31)	(1.095E+00, 9.205E-30)	
13	(-4.11E-01, 0.)	(3.143E+00, 0.)	(-2.192E+01, 0.)	
14	(0.)	(0.)	(0.)	
15	(0.)	(0.)	(0.)	

 CONTROL RESIDUE MATRIX (15 BY 7)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

ORIGINAL PAGE IS
OF POOR QUALITY

1	(9.617E-04, -4.095E+00)	(2.109E-04, -9.468E+01)	(4.735E-03, 6.890E+00)	(4.044E-04, 1.119E+02)
2	(9.617E-04, 4.095E+00)	(2.109E-04, 9.468E+01)	(4.735E-03, -6.890E+00)	(4.044E-04, -1.119E+02)
3	(1.261E-08, 1.129E+02)	(1.128E-08, -1.404E+02)	(2.48E-07, -4.991E+01)	(3.662E-08, -1.453E+02)
4	(1.261E-08, -1.129E+02)	(1.128E-08, 1.404E+02)	(2.48E-07, 4.991E+01)	(3.662E-08, 1.453E+02)
5	(3.079E-02, 1.511E+02)	(7.131E-03, 5.426E+01)	(9.482E-02, 1.473E+02)	(2.784E-03, -3.211E+01)
6	(3.079E-02, -1.511E+02)	(7.131E-03, -5.426E+01)	(9.482E-02, -1.473E+02)	(2.784E-03, 3.211E+01)
7	(4.945E-01, 1.645E+02)	(5.178E-02, 7.231E+01)	(3.087E-01, 1.677E+02)	(1.519E-02, -1.166E+01)
8	(4.945E-01, -1.645E+02)	(5.178E-02, -7.231E+01)	(3.087E-01, -1.677E+02)	(1.519E-02, 1.166E+01)
9	(2.316E+01, 1.090E+02)	(5.101E-01, 3.923E+01)	(6.833E-01, 1.681E+02)	(3.754E-01, -5.085E+01)
10	(2.316E+01, -1.090E+02)	(5.101E-01, -3.923E+01)	(6.833E-01, -1.681E+02)	(3.754E-01, 5.085E+01)
11	(6.453E+01, -6.510E-28)	(3.029E-01, 1.800E+02)	(4.928E-02, 1.800E+02)	(2.078E-01, 1.800E+02)
12	(4.581E+01, -1.800E+02)	(2.102E-01, -1.800E+02)	(2.656E-02, 4.823E-28)	(2.951E-01, -1.800E+02)
13	(2.710E+00, 1.800E+02)	(3.170E-01, 1.800E+02)	(2.113E+00, 0.)	(5.319E-03, 1.800E+02)
14	(0.)	(0.)	(0.)	(0.)
15	(0.)	(0.)	(0.)	(0.)
1	(2.850E-03, -1.927E+01)	(6.399E-02, 8.231E+01)	(3.179E-01, 3.447E+01)	(3.179E-01, 3.447E+01)
2	(2.850E-03, 1.927E+01)	(6.399E-02, -8.231E+01)	(3.179E-01, -3.447E+01)	(3.179E-01, -3.447E+01)
3	(6.91E-06, -1.625E+02)	(1.522E-04, -7.196E+01)	(3.478E-04, -1.641E+02)	(3.478E-04, -1.641E+02)
4	(6.91E-06, 1.625E+02)	(1.522E-04, 7.196E+01)	(3.478E-04, 1.641E+02)	(3.478E-04, 1.641E+02)
5	(1.543E-01, 2.998E+01)	(2.051E+00, 1.230E+02)	(9.970E+00, 3.194E+01)	(9.970E+00, 3.194E+01)
6	(1.543E-01, -2.998E+01)	(2.051E+00, -1.230E+02)	(9.970E+00, -3.194E+01)	(9.970E+00, -3.194E+01)
7	(1.658E-01, -1.293E+02)	(9.885E-01, -3.384E+01)	(2.044E+00, -1.020E+02)	(2.044E+00, -1.020E+02)
8	(1.658E-01, 1.293E+02)	(9.885E-01, 3.384E+01)	(2.044E+00, 1.020E+02)	(2.044E+00, 1.020E+02)
9	(9.554E-01, 6.084E+01)	(1.290E+00, -1.703E+02)	(1.349E+01, 7.370E+01)	(1.349E+01, 7.370E+01)
10	(9.554E-01, -6.084E+01)	(1.290E+00, 1.703E+02)	(1.349E+01, -7.370E+01)	(1.349E+01, -7.370E+01)
11	(3.825E-01, 1.800E+02)	(6.223E-02, 1.800E+02)	(1.013E+00, 1.800E+02)	(1.013E+00, 1.800E+02)
12	(1.399E-01, -1.800E+02)	(1.769E-02, 4.823E-28)	(1.032E+00, 4.823E-28)	(1.032E+00, 4.823E-28)
13	(4.714E-01, 1.800E+02)	(3.143E+00, 0.)	(2.192E+01, 1.800E+02)	(2.192E+01, 1.800E+02)
14	(0.)	(0.)	(0.)	(0.)
15	(0.)	(0.)	(0.)	(0.)

THE D-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(-7.079E-05, -3.532E-05)	(-7.587E-06, -5.60E-05)	(-3.090E-04, -2.371E-04)	(2.640E-05, -2.024E-05)
2	(-7.079E-05, 3.532E-05)	(-7.587E-06, -5.60E-05)	(-3.090E-04, 2.371E-04)	(2.640E-05, 2.024E-05)
3	(-5.705E-10, 3.540E-10)	(-1.574E-10, -5.793E-10)	(1.280E-08, -3.348E-09)	(-6.679E-10, -1.832E-09)
4	(-5.705E-10, -3.540E-10)	(-1.574E-10, 5.793E-10)	(1.280E-08, 3.348E-09)	(-6.679E-10, 1.832E-09)
5	(-4.750E-05, -2.695E-06)	(6.948E-07, 1.100E-05)	(-1.465E-04, 1.544E-06)	(4.301E-06, 1.466E-09)
6	(-4.750E-05, 2.695E-06)	(6.948E-07, -1.100E-05)	(-1.465E-04, -1.544E-06)	(4.301E-06, -1.466E-09)
7	(-1.967E-03, -3.832E-04)	(-3.229E-05, 2.074E-04)	(-1.212E-03, -3.086E-04)	(5.950E-05, -1.582E-05)
8	(-1.967E-03, 3.832E-04)	(-3.229E-05, -2.074E-04)	(-1.212E-03, 3.086E-04)	(5.950E-05, 1.582E-05)
9	(-4.228E-03, 7.276E-03)	(1.182E-04, 1.427E-04)	(-2.482E-04, 3.365E-06)	(1.049E-04, -8.718E-05)
10	(-4.228E-03, -7.276E-03)	(1.182E-04, -1.427E-04)	(-2.482E-04, -3.365E-06)	(1.049E-04, 8.718E-05)
11	(5.73E-03, -8.968E-28)	(-2.706E-05, 4.203E-30)	(-4.402E-06, 6.838E-31)	(-1.856E-05, 2.883E-30)
12	(5.922E-03, 2.914E-28)	(2.717E-05, 1.337E-30)	(-3.434E-06, -1.690E-31)	(3.815E-05, 1.877E-30)
13	(0, 0)	(0, 0)	(0, 0)	(0, 0)
14	(-7.536E-02, 0)	(-2.352E-02, 0)	(2.235E-01, 0)	(-2.526E-02, 0)
15	(7.629E-02, 0)	(2.337E-02, 0)	(-2.195E-01, 0)	(2.485E-02, 0)

	5	6	7
1	(-2.299E-04, -4.614E-05)	(2.050E-03, -4.849E-03)	(-1.102E-02, -2.372E-02)
2	(-2.299E-04, 4.614E-05)	(2.050E-03, 4.849E-03)	(-1.102E-02, 2.372E-02)
3	(-2.227E-07, -2.930E-07)	(6.496E-06, -4.844E-06)	(-1.163E-05, -1.441E-05)
4	(-2.227E-07, 2.930E-07)	(6.496E-06, 4.844E-06)	(-1.163E-05, 1.441E-05)
5	(1.115E-04, 2.107E-04)	(-2.875E-03, 1.333E-03)	(6.736E-03, 1.385E-02)
6	(1.115E-04, -2.107E-04)	(-2.875E-03, -1.333E-03)	(6.736E-03, -1.385E-02)
7	(-1.481E-04, -6.555E-04)	(3.973E-03, -5.089E-04)	(2.080E-03, -8.018E-03)
8	(-1.481E-04, 6.555E-04)	(3.973E-03, 5.089E-04)	(2.080E-03, 8.018E-03)
9	(1.075E-04, 3.301E-04)	(-4.346E-04, -1.654E-04)	(4.422E-04, 4.882E-03)
10	(1.075E-04, -3.301E-04)	(-4.346E-04, 1.654E-04)	(4.422E-04, -4.882E-03)
11	(-3.417E-05, 5.308E-30)	(-5.559E-05, 8.636E-31)	(-5.045E-05, 1.405E-29)
12	(1.808E-05, 8.900E-31)	(-2.286E-06, -1.125E-31)	(-1.414E-04, -6.956E-30)
13	(0, 0)	(0, 0)	(0, 0)
14	(2.289E-02, 0)	(-2.173E-01, 0)	(2.407E+00, 0)
15	(-2.254E-02, 0)	(2.119E-01, 0)	(-2.352E+00, 0)

DISTURBANCE RESIDUE MATRIX (15 BY 7)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

ORIGINAL PAGE IS
OF POOR QUALITY

1	(7.911E-05, -1.535E+02)	1	(1.735E-05, 1.159E+02)	3	(3.895E-04, -1.425E+02)	4	(3.327E-05, -3.748E+01)
2	(7.911E-05, 1.535E+02)		(1.735E-05, -1.159E+02)		(3.895E-04, 1.425E+02)		(3.327E-05, 3.748E+01)
3	(6.717E-10, 1.482E+02)		(6.008E-10, -1.052E+02)		(1.323E-08, -1.466E+01)		(1.950E-09, -1.100E+02)
4	(6.717E-10, -1.482E+02)		(6.008E-10, 1.052E+02)		(1.323E-08, 1.466E+01)		(1.950E-09, 1.100E+02)
5	(4.757E-05, -1.768E+02)		(1.102E-05, 8.638E+01)		(1.465E-04, 1.794E+02)		(4.301E-06, 1.953E-02)
6	(4.757E-05, 1.768E+02)		(1.102E-05, -8.638E+01)		(1.465E-04, -1.794E+02)		(4.301E-06, -1.953E-02)
7	(2.004E-03, -1.690E+02)		(2.099E-04, 9.895E+01)		(1.251E-03, -1.657E+02)		(6.157E-05, 1.489E+01)
8	(2.004E-03, 1.690E+02)		(2.099E-04, -9.895E+01)		(1.251E-03, 1.657E+02)		(6.157E-05, -1.489E+01)
9	(8.415E-03, 1.202E+02)		(1.853E-04, 5.036E+01)		(2.483E-04, 1.792E+02)		(1.364E-04, -3.973E+01)
10	(8.415E-03, -1.202E+02)		(1.853E-04, -5.036E+01)		(2.483E-04, -1.792E+02)		(1.364E-04, 3.973E+01)
11	(5.773E-03, -8.501E-24)		(2.706E-05, 1.800E+02)		(4.402E-06, 1.800E+02)		(1.856E-05, 1.800E+02)
12	(5.773E-03, 8.501E-24)		(2.706E-05, -1.800E+02)		(4.402E-06, -1.800E+02)		(1.856E-05, -1.800E+02)
13	(0. , 0.)		(0. , 0.)		(0. , 0.)		(0. , 0.)
14	(7.535E-02, 1.800E+02)		(2.352E-02, 1.800E+02)		(2.235E-01, 0.)		(2.526E-02, 1.800E+02)
15	(7.535E-02, 0.)		(2.337E-02, 0.)		(2.195E-01, 1.800E+02)		(2.485E-02, 0.)
1	(2.245E-04, -1.687E+02)	5	(2.264E-03, -6.708E+01)	6	(2.615E-02, -1.149E+02)	7	(2.615E-02, 1.149E+02)
2	(2.345E-04, 1.687E+02)		(5.264E-03, 6.708E+01)		(2.615E-02, 1.149E+02)		(2.615E-02, -1.149E+02)
3	(3.680E-07, -1.272E+02)		(8.103E-06, -3.671E+01)		(1.852E-05, -1.283E+02)		(1.852E-05, 1.283E+02)
4	(3.680E-07, 1.272E+02)		(8.103E-06, 3.671E+01)		(1.852E-05, 1.283E+02)		(1.852E-05, -1.283E+02)
5	(2.383E-04, 6.211E+01)		(3.169E-03, 1.551E+02)		(1.540E-02, 6.407E+01)		(1.540E-02, -6.407E+01)
6	(2.383E-04, -6.211E+01)		(3.169E-03, -1.551E+02)		(1.540E-02, -6.407E+01)		(1.540E-02, 6.407E+01)
7	(6.721E-04, -1.027E+02)		(4.006E-03, -7.298E+00)		(8.283E-03, -7.545E+01)		(8.283E-03, 7.545E+01)
8	(6.721E-04, 1.027E+02)		(4.006E-03, 7.298E+00)		(8.283E-03, 7.545E+01)		(8.283E-03, -7.545E+01)
9	(3.472E-04, 7.197E+01)		(4.650E-04, -1.532E+02)		(4.902E-03, 8.482E+01)		(4.902E-03, -8.482E+01)
10	(3.472E-04, -7.197E+01)		(4.650E-04, 1.532E+02)		(4.902E-03, -8.482E+01)		(4.902E-03, 8.482E+01)
11	(3.417E-05, 1.800E+02)		(5.559E-06, 1.800E+02)		(9.045E-05, 1.800E+02)		(9.045E-05, -1.800E+02)
12	(1.806E-05, -8.20E-24)		(2.286E-06, -1.800E+02)		(1.414E-04, -1.800E+02)		(1.414E-04, 1.800E+02)
13	(0. , 0.)		(0. , 0.)		(0. , 0.)		(0. , 0.)
14	(2.283E-02, 0.)		(2.173E-01, 1.900E+02)		(2.407E+00, 0.)		(2.407E+00, 0.)
15	(2.254E-02, 1.800E+02)		(2.119E-01, 0.)		(2.352E+00, 1.800E+02)		(2.352E+00, -1.800E+02)

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CONFIGURATION 5

THE AU		MATRIX (12 BY 12)											
		1	2	3	4	5	6						
1	-1.208E+00	9.440E-01	-6.340E-04	0.	-8.940E-03	9.525E-02							
2	-7.059E+00	-2.018E+00	-2.290E-03	0.	-1.842E-01	-1.248E-01							
3	-2.500E+01	0.	-2.500E-02	-3.220E+01	0.	0.	0.						
4	0.	1.000E+00	0.	0.	0.	0.	0.						
5	0.	0.	0.	0.	0.	0.	0.						
6	0.	0.	0.	0.	0.	0.	0.						
7	0.	0.	0.	0.	0.	0.	0.						
8	0.	0.	0.	0.	0.	0.	0.						
9	-7.383E+02	-1.333E+02	-1.435E-03	0.	-1.287E+02	-1.568E+01							
10	1.300E+03	1.632E+01	0.	0.	1.407E+01	-5.061E+02							
11	7.577E+02	5.595E+01	-3.900E-03	0.	6.990E+00	3.458E+01							
12	1.688E+00	3.990E-02	0.	0.	1.623E-02	-9.700E-02							
		7	8	9	10	11	12						
1	4.613E-03	-4.346E-03	-2.130E-04	2.590E-03	1.526E-04	-4.998E-06							
2	2.072E-01	-9.171E-02	-7.438E-03	4.972E-02	6.963E-03	-2.004E-03							
3	0.	0.	0.	0.	0.	0.							
4	0.	0.	0.	0.	0.	0.							
5	0.	0.	1.000E+00	0.	0.	0.							
6	0.	0.	0.	1.000E+00	0.	0.							
7	0.	0.	0.	0.	1.000E+00	0.							
8	0.	0.	0.	0.	0.	1.000E+00							
9	-1.540E+01	2.088E+01	-1.062E+00	-2.770E-01	9.159E-01	-1.977E-01							
10	6.593E+00	1.124E+01	2.351E-01	-8.595E+00	1.131E-01	1.120E-01							
11	7.111E+02	3.457E+00	-1.219E-01	3.784E+00	-4.672E-01	-2.535E-01							
12	7.111E-03	-4.849E+02	-3.290E-04	2.427E-03	-2.764E-04	-4.080E-04							

THE AC MATRIX (2 BY 2)

	1	2
1	-9.400E+00	0.
2	-2.255E-02	-9.500E+00

THE D MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	-7.371E+02
10	0.	1.298E+03
11	0.	7.554E+02
12	0.	1.697E+00

THE E VECTOR (7 BY 1)

	1
1	0.
2	0.
3	0.
4	0.
5	0.
6	0.
7	2.327E+00

THE F MATRIX (7 BY 2)

	1	2
1	0.	0.
2	0.	0.
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	9.243E+00

THE CG VECTOR (15 BY 1)

```

1 0.
2 1.000E+00
3 5.621E-03
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

```

AP = -5.667E+00

THE CP VECTOR (15 BY 1)

```

1 1.000E+00
2 0.
3 0.
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

```

THE A0-SCALED MATRIX (12 BY 12)

	1	2	3	4	5	6
1	-1.208E+00	9.440E-01	-6.017E-01	0.	3.386E-01	-2.886E+00
2	-7.059E+00	-2.018E+00	-2.173E+00	0.	6.977E+00	3.782E+00
3	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.	0.
4	0.	1.000E+00	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	1.949E+01	3.519E+00	3.595E-02	0.	-1.267E+02	-1.254E+01
10	-4.280E+01	-5.389E-01	0.	0.	1.759E+01	-5.061E+02
11	-2.615E+01	-1.934E+00	1.279E-01	0.	9.151E+00	3.621E+01
12	-6.136E-02	-1.451E-03	0.	0.	2.235E-02	-1.069E-01
	7	8	9	10	11	12
1	-1.336E-01	1.195E-01	8.168E-03	-7.848E-02	-4.416E-03	1.375E-04
2	-5.995E+00	2.522E+00	1.817E-01	-1.507E+00	-2.015E-01	5.512E-02
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	1.000E+00	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.	0.
7	0.	0.	0.	0.	1.000E+00	0.
8	0.	0.	0.	0.	0.	1.000E+00
9	-1.176E+01	1.516E+01	-1.062E+00	-2.216E-01	5.996E-01	-1.435E-01
10	6.295E+00	1.020E+01	2.939E-01	-8.595E+00	1.080E-01	1.017E-01
11	-1.439E+02	3.286E+00	-1.596E-01	3.963E+00	-4.677E-01	-2.410E-01
12	7.482E-03	-4.849E+02	-4.531E-04	2.674E-03	-2.908E-04	-4.083E-01

THE B-SCALED VECTOR (12 BY 1)

	1
1	-2.884E-01
2	-1.503E+01
3	0.
4	0.
5	0.
6	0.
7	0.
8	0.
9	5.886E+01
10	7.102E+00
11	-2.120E+01
12	-3.921E-03

THE C-SCALED MATRIX (7 BY 12)

	1	2	3	4	5	6
1	0.	0.	9.490E+02	0.	0.	0.
2	0.	0.	0.	1.000E+00	0.	0.
3	0.	1.000E+00	0.	0.	0.	0.
4	-1.000E+00	0.	0.	1.000E+00	0.	0.
5	0.	0.	0.	1.000E+00	-1.000E+00	-1.000E+00
6	0.	1.000E+00	0.	0.	0.	0.
7	9.322E+00	-1.395E+00	1.350E+01	0.	-4.100E+01	-9.740E+01

	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	-1.000E+00	-1.000E+00	0.	0.	0.	0.
6	0.	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-3.063E+01	-4.599E+01	-3.425E+02	-3.342E+00	-1.437E+02	-3.964E+03

THE E-SCALED MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.045E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	1.946E+01
10	0.	-4.283E+01
11	0.	-2.614E+01
12	0.	-6.170E+02

THE AA MATRIX (15 BY 15)

1	2	3	4	5	6	7	8
1 -6.667E+00	0.400E+00	0.	0.	0.	0.	0.	0.
2 0.	-9.400E+00	0.	0.	0.	0.	0.	0.
3 0.	-2.250E-02	-9.500E+00	0.	0.	0.	0.	0.
4 -2.884E-01	0.	-1.204E+00	-1.208E+00	9.440E-01	-6.017E-01	0.	3.386E-01
5 -1.503E+01	0.	-7.049E+00	-7.059E+00	-2.018E+00	-2.173E+00	0.	6.977E+00
6 0.	0.	0.	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.
7 0.	0.	0.	0.	1.000E+00	0.	0.	0.
8 0.	0.	0.	0.	0.	0.	0.	0.
9 0.	0.	0.	0.	0.	0.	0.	0.
10 0.	0.	0.	0.	0.	0.	0.	0.
11 0.	0.	0.	0.	0.	0.	0.	0.
12 5.886E+01	0.	9.46E+01	1.949E+01	3.515E+00	3.595E-02	0.	-1.287E+02
13 7.103E+00	0.	-4.283E+01	-4.290E+01	-5.389E-01	0.	0.	1.759E+01
14 -2.120E+01	0.	-2.614E+01	-2.619E+01	-1.934E+00	1.279E-01	0.	9.151E+00
15 -3.921E-03	0.	-6.170E-02	-6.133E-02	-1.451E-03	0.	0.	2.235E-02
9	10	11	12	13	14	15	
1 0.	0.	0.	0.	0.	0.	0.	
2 0.	0.	0.	0.	0.	0.	0.	
3 0.	0.	0.	0.	0.	0.	0.	
4 -2.886E+00	-1.336E-01	1.195E-01	8.058E-03	-7.848E-02	-4.416E-03	1.373E-04	
5 -3.782E+00	-5.995E+00	2.522E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02	
6 0.	0.	0.	0.	0.	0.	0.	
7 0.	0.	0.	1.000E+00	0.	0.	0.	
8 0.	0.	0.	0.	1.000E+00	0.	0.	
9 0.	0.	0.	0.	0.	1.000E+00	0.	
10 0.	0.	0.	0.	0.	0.	1.000E+00	
11 0.	0.	0.	0.	0.	0.	0.	
12 -1.254E+01	-1.175E+01	1.516E+01	-1.062E+00	-2.216E-01	0.992E-01	-1.435E-01	
13 -5.061E+02	6.293E+00	1.020E+01	2.839E-01	-3.592E+00	1.690E-01	0.017E-01	
14 3.621E+01	-1.439E+02	3.286E+00	-1.596E-01	3.553E+00	-4.677E-01	-2.410E-01	
15 -1.065E-01	7.482E-03	-4.845E+02	-4.531E-04	2.674E-03	-2.508E-04	1.080E-01	

THE CC MATRIX (7 BY 15)

	1	2	3	4	5
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	1.000E+00
4	0.	0.	-1.000E+00	0.	0.
5	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	1.000E+00
7	2.327E+00	0.	9.243E+00	9.322E+00	-1.395E+00

	6	7	8	9	10
1	9.490E+02	0.	0.	0.	0.
2	0.	1.000E+00	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	1.000E+00	0.	0.	0.
5	0.	1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
6	0.	0.	0.	0.	0.
7	1.350E+01	0.	-4.100E+01	-9.740E+01	-3.363E+01

	11	12	13	14	15
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.
5	-1.000E+00	0.	0.	0.	0.
6	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-4.599E+01	-3.425E-02	-3.342E+00	-1.437E-02	-3.964E-03

SPECTRAL DECOMPOSITION OF A-AUG

	REAL PART	IMAGINARY PART	FREQUENCY (HERTZ)	DAMPING RATIO	TIME CONST. (SEC/RAD)
1	-4.50739E+00	2.20024E+01	3.57451E+00	.20069099	2.21858E-01
3	-2.03839E-01	2.20195E-01	3.50466E+00	.00925023	4.90582E+00
5	2.12155E-02	1.16211E+01	1.84955E-00	-.00182360	-4.71354E+01
7	-5.90432E-01	1.17271E+01	1.87307E+01	.08415745	1.00961E+00
9	-1.21309E+00	2.21222E+00	4.01547E-01	.48081249	8.2434E-01
11	1.27992E-03	7.53298E-02	1.19908E-02	-.01698856	-7.81275E+02
13	-6.5627E+00	0.	0.	1.00000000	1.50000E-01
14	-9.50000E+00	0.	0.	1.00000000	1.05253E-01
15	-9.40000E+00	0.	0.	1.00000000	1.05253E-01

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THE EE MATRIX (15 BY 15)

1	2	3	4
1 (0.)	(0.)	(0.)	(0.)
2 (0.)	(0.)	(0.)	(0.)
3 (0.)	(0.)	(0.)	(0.)
4 (-4.773E-03, -7.194E-03)	(-4.773E-03, -7.194E-03)	(-4.178E-06, -1.533E-04)	(-4.178E-06, -1.533E-04)
5 (5.245E-02, -4.290E-02)	(5.245E-02, -4.290E-02)	(-1.723E-03, -2.672E-04)	(-1.723E-03, -2.672E-04)
6 (9.266E-06, -1.121E-05)	(9.266E-06, -1.121E-05)	(6.247E-08, -2.309E-08)	(6.247E-08, -2.309E-08)
7 (-2.340E-03, -1.904E-03)	(-2.340E-03, -1.904E-03)	(-1.141E-05, -7.835E-05)	(-1.141E-05, -7.835E-05)
8 (-5.644E-04, -1.415E-03)	(-5.644E-04, -1.415E-03)	(7.469E-04, -1.784E-03)	(7.469E-04, -1.784E-03)
9 (-2.660E-02, 3.406E-02)	(-2.660E-02, 3.406E-02)	(-2.307E-03, -2.759E-04)	(-2.307E-03, -2.759E-04)
10 (9.857E-03, -1.386E-03)	(9.857E-03, -1.386E-03)	(9.005E-04, 8.471E-04)	(9.005E-04, 8.471E-04)
11 (2.769E-05, 4.865E-06)	(2.769E-05, 4.865E-06)	(-5.866E-03, -4.416E-02)	(-5.866E-03, -4.416E-02)
12 (-2.960E-02, -1.880E-02)	(-2.960E-02, -1.880E-02)	(-3.944E-03, -1.608E-02)	(-3.944E-03, -1.608E-02)
13 (-5.295E-01, -7.388E-01)	(-5.295E-01, -7.388E-01)	(6.546E-03, -5.075E-02)	(6.546E-03, -5.075E-02)
14 (-1.393E-02, -2.231E-01)	(-1.393E-02, -2.231E-01)	(-1.884E-02, -1.966E-02)	(-1.884E-02, -1.966E-02)
15 (-2.318E-04, 5.870E-04)	(-2.318E-04, 5.870E-04)	(9.744E-01, -2.082E-01)	(9.744E-01, -2.082E-01)
5	6	7	8
1 (0.)	(0.)	(0.)	(0.)
2 (0.)	(0.)	(0.)	(0.)
3 (0.)	(0.)	(0.)	(0.)
4 (4.042E-04, -1.370E-03)	(4.042E-04, -1.370E-03)	(-2.860E-03, -3.830E-03)	(-2.860E-03, -3.830E-03)
5 (-1.216E-02, 1.028E-02)	(-1.216E-02, 1.028E-02)	(3.181E-02, -4.214E-02)	(3.181E-02, -4.214E-02)
6 (-6.180E-06, 3.469E-06)	(-6.180E-06, 3.469E-06)	(1.400E-05, -1.856E-05)	(1.400E-05, -1.856E-05)
7 (8.826E-04, 1.048E-03)	(8.826E-04, 1.048E-03)	(-3.795E-03, -2.337E-03)	(-3.795E-03, -2.337E-03)
8 (-4.252E-02, 4.151E-02)	(-4.252E-02, 4.151E-02)	(5.119E-02, -4.761E-02)	(5.119E-02, -4.761E-02)
9 (-2.148E-03, 2.920E-03)	(-2.148E-03, 2.920E-03)	(2.405E-03, 3.340E-03)	(2.405E-03, 3.340E-03)
10 (-1.843E-02, 5.885E-02)	(-1.843E-02, 5.885E-02)	(-2.722E-02, 3.877E-02)	(-2.722E-02, 3.877E-02)
11 (-1.490E-06, 3.364E-06)	(-1.490E-06, 3.364E-06)	(2.974E-06, -3.645E-06)	(2.974E-06, -3.645E-06)
12 (-4.833E-01, -4.933E-01)	(-4.833E-01, -4.933E-01)	(-5.090E-01, -5.532E-01)	(-5.090E-01, -5.532E-01)
13 (-3.398E-02, -2.490E-02)	(-3.398E-02, -2.490E-02)	(-4.155E-02, -2.490E-02)	(-4.155E-02, -2.490E-02)
14 (-6.843E-01, -2.130E-01)	(-6.843E-01, -2.130E-01)	(-4.277E-01, -3.576E-01)	(-4.277E-01, -3.576E-01)
15 (-3.936E-05, -1.724E-05)	(-3.936E-05, -1.724E-05)	(-4.569E-05, -3.127E-05)	(-4.569E-05, -3.127E-05)
9	10	11	12
1 (0.)	(0.)	(0.)	(0.)
2 (0.)	(0.)	(0.)	(0.)
3 (0.)	(0.)	(0.)	(0.)
4 (3.553E-01, -2.567E-02)	(3.553E-01, -2.567E-02)	(8.305E-02, -1.777E-01)	(8.305E-02, -1.777E-01)
5 (-5.678E-02, 8.290E-01)	(-5.678E-02, 8.290E-01)	(-1.741E-02, 6.501E-02)	(-1.741E-02, 6.501E-02)
6 (5.588E-03, 5.831E-03)	(5.588E-03, 5.831E-03)	(-1.726E-01, -3.557E-01)	(-1.726E-01, -3.557E-01)
7 (2.989E-01, -1.382E-01)	(2.989E-01, -1.382E-01)	(8.588E-01, -2.457E-01)	(8.588E-01, -2.457E-01)
8 (6.369E-02, 2.092E-02)	(6.369E-02, 2.092E-02)	(1.413E-02, 2.951E-02)	(1.413E-02, 2.951E-02)
9 (-2.947E-02, 2.821E-03)	(-2.947E-02, 2.821E-03)	(-6.708E-03, -1.439E-02)	(-6.708E-03, -1.439E-02)
10 (-5.794E-02, 5.729E-03)	(-5.794E-02, 5.729E-03)	(-1.565E-02, -3.352E-02)	(-1.565E-02, -3.352E-02)
11 (-3.650E-05, 2.410E-07)	(-3.650E-05, 2.410E-07)	(-8.580E-06, -1.827E-05)	(-8.580E-06, -1.827E-05)
12 (-1.236E-01, -1.155E-01)	(-1.236E-01, -1.155E-01)	(2.241E-03, -1.026E-03)	(2.241E-03, -1.026E-03)
13 (2.951E-02, 6.861E-02)	(2.951E-02, 6.861E-02)	(-1.092E-02, -4.669E-04)	(-1.092E-02, -4.669E-04)

ORIGINAL PAGE IS
OF POOR QUALITY

14	(1.017E-01, -1.397E-01)	(1.017E-01, 1.397E-01)	(-2.545E-03, -1.151E-03)	(-2.545E-03, 1.151E-03)			
15	(4.374E-05, -8.103E-05)	(4.374E-05, 8.103E-05)	(-1.388E-06, -6.229E-07)	(-1.388E-06, 6.229E-07)			
1	(2.866E-01, 0.	13	(0.	14	(0.	15	(0.
2	(0.	)	( 0.	)	( 8.873E-01, 0.	)	( 8.873E-01, 0.
3	(0.	)	( 4.341E-01, 0.	)	(-2.002E-01, 0.	)	(-2.002E-01, 0.
4	(-9.023E-02, 0.	)	( 1.664E-03, 0.	)	(-5.373E-04, 0.	)	(-5.373E-04, 0.
5	(6.110E-01, 0.	)	( 4.380E-01, 0.	)	(-2.038E-01, 0.	)	(-2.038E-01, 0.
6	(-8.261E-04, 0.	)	(-1.605E-04, 0.	)	( 7.696E-05, 0.	)	( 7.696E-05, 0.
7	(-9.165E-02, 0.	)	(-4.611E-02, 0.	)	( 2.163E-02, 0.	)	( 2.163E-02, 0.
8	(1.050E-01, 0.	)	( 5.422E-02, 0.	)	(-2.524E-02, 0.	)	(-2.524E-02, 0.
9	(1.441E-02, 0.	)	(-3.568E-02, 0.	)	( 1.647E-02, 0.	)	( 1.647E-02, 0.
10	(-1.988E-02, 0.	)	(-5.054E-02, 0.	)	( 2.351E-02, 0.	)	( 2.351E-02, 0.
11	(7.986E-06, 0.	)	(-3.829E-05, 0.	)	( 1.769E-05, 0.	)	( 1.769E-05, 0.
12	(-6.927E-01, 0.	)	(-5.151E-01, 0.	)	( 2.373E-01, 0.	)	( 2.373E-01, 0.
13	(-9.605E-02, 0.	)	( 3.330E-01, 0.	)	(-1.546E-01, 0.	)	(-1.546E-01, 0.
14	(1.366E-01, 0.	)	( 4.802E-01, 0.	)	(-2.210E-01, 0.	)	(-2.210E-01, 0.
15	(-5.326E-05, 0.	)	( 3.637E-04, 0.	)	(-1.663E-04, 0.	)	(-1.663E-04, 0.

THE CON VECTOR (15 BY 1)

```

1 ( 5.805E-02, 5.53E-02 )
2 ( 5.805E-02, -5.53E-02 )
3 ( -7.423E-05, 1.247E-04 )
4 ( -7.429E-05, -1.247E-04 )
5 ( 1.844E+00, 4.036E-01 )
6 ( 1.844E+00, -4.036E-01 )
7 ( -2.575E+00, 9.316E-01 )
8 ( -2.576E+00, 9.316E-01 )
9 ( 3.603E-01, 1.089E+00 )
10 ( 3.603E-01, -1.089E+00 )
11 ( -1.135E-01, 3.863E-02 )
12 ( -1.135E-01, -3.863E-02 )
13 ( 3.489E+00, 0. )
14 ( 0. , 0. )
15 ( 0. , 0. )

```

CONTROLABILITY MATRIX (15 BY 1)
OUTPUT FORM: (MAGNITUDE , PHASE(DEC.))

```

1 ( 8.034E-02, 4.373E+01 )
2 ( 8.034E-02, -4.373E+01 )
3 ( 1.452E-04, 1.208E+02 )
4 ( 1.452E-04, -1.208E+02 )
5 ( 1.808E+00, 1.235E+01 )
6 ( 1.808E+00, -1.235E+01 )
7 ( 2.735E+00, -1.601E+02 )
8 ( 2.735E+00, 1.601E+02 )
9 ( 1.147E+00, 7.170E+01 )
10 ( 1.147E+00, -7.170E+01 )
11 ( 1.195E-01, 1.612E+02 )
12 ( 1.195E-01, -1.612E+02 )
13 ( 3.489E+00, 0. )
14 ( 0. , 0. )
15 ( 0. , 0. )

```

ORIGINAL PAGE IS
OF POOR QUALITY

THE DIST VECTOR (15 BY 1)

```

1 (-1.248E-03, -5.521E-03)
2 (-1.248E-03, 5.521E-03)
3 (-7.829E-06, 3.280E-06)
4 (-7.829E-06, -3.280E-06)
5 ( 6.152E-03, 9.611E-04)
6 ( 6.152E-03, -9.611E-04)
7 (-3.926E-03, 6.826E-03)
8 (-3.926E-03, -6.826E-03)
9 (-3.398E-04, 1.260E-03)
10 (-3.398E-04, -1.260E-03)
11 (-1.105E-05, 1.967E-05)
12 (-1.105E-05, -1.967E-05)
13 ( 0, 0 )
14 ( 5.327E-01, 0 )
15 ( 1.127E+00, 0 )

```

DISTURBABILITY MATRIX (15 BY 1)
OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1 ( 5.660E-03, -1.027E+02 )
2 ( 5.660E-03, 1.027E+02 )
3 ( 9.488E-06, 1.573E+01 )
4 ( 8.488E-06, -1.573E+02 )
5 ( 6.233E-03, 8.870E+00 )
6 ( 6.233E-03, -8.870E+00 )
7 ( 7.875E-03, -1.199E+02 )
8 ( 7.875E-03, 1.199E+02 )
9 ( 1.305E-03, 1.051E+02 )
10 ( 1.305E-03, -1.051E+02 )
11 ( 2.256E-05, -1.194E+02 )
12 ( 2.256E-05, 1.194E+02 )
13 ( 0, 0 )
14 ( 5.327E-01, 0 )
15 ( 1.127E+00, 0 )

```

THE OBS MATRIX (7 BY 15)

1	(8.793E-03, -1.064E-02)	(8.793E-03, 1.064E-02)	(5.928E-05, -2.191E-05)	(5.928E-05, 2.191E-05)	4
2	(-2.340E-03, -1.904E-03)	(-2.340E-03, 1.904E-03)	(-1.141E-05, 7.935E-05)	(-1.141E-05, -7.935E-05)	
3	(5.245E-02, -4.290E-02)	(5.245E-02, 4.290E-02)	(-1.723E-03, -2.672E-04)	(-1.723E-03, 2.672E-04)	
4	(2.433E-03, 5.289E-03)	(2.433E-03, -5.289E-03)	(-7.230E-06, 2.316E-04)	(-7.230E-06, -2.316E-04)	
5	(1.494E-02, -3.600E-02)	(1.494E-02, 3.600E-02)	(1.051E-02, 4.188E-02)	(1.051E-02, -4.188E-02)	
6	(7.247E-01, 4.910E-01)	(7.247E-01, -4.910E-01)	(-9.244E-01, 2.230E-01)	(-9.244E-01, -2.230E-01)	
7	(4.269E+00, -8.698E-01)	(4.269E+00, 8.698E-01)	(5.957E-01, 2.124E+00)	(5.957E-01, -2.124E+00)	
1	(-5.865E-03, 3.292E-03)	(-5.865E-03, -3.292E-03)	(1.328E-02, -1.761E-02)	(1.328E-02, 1.761E-02)	8
2	(8.825E-04, 1.048E-03)	(8.825E-04, -1.048E-03)	(-3.795E-03, -2.392E-03)	(-3.795E-03, 2.392E-03)	
3	(-1.216E-02, 1.028E-02)	(-1.216E-02, -1.028E-02)	(3.181E-02, -4.214E-02)	(3.181E-02, 4.214E-02)	
4	(4.784E-04, -3.215E-04)	(4.784E-04, 3.215E-04)	(-9.348E-04, 1.437E-03)	(-9.348E-04, -1.437E-03)	
5	(6.399E-02, -1.022E-01)	(6.399E-02, 1.022E-01)	(-3.018E-02, 9.211E-02)	(-3.018E-02, -9.211E-02)	
6	(1.190E+00, 7.415E-01)	(1.190E+00, -7.415E-01)	(1.110E+00, -2.626E-01)	(1.110E+00, 2.626E-01)	
7	(2.733E+00, -3.864E+00)	(2.733E+00, 3.864E+00)	(-1.323E+00, -3.655E+00)	(-1.323E+00, 3.655E+00)	
1	(5.274E+00, 5.534E+00)	(5.274E+00, -5.534E+00)	(-1.638E+02, 3.375E+02)	(-1.638E+02, -3.375E+02)	12
2	(2.989E-01, -1.362E-01)	(2.989E-01, 1.362E-01)	(8.588E-01, 2.457E-01)	(8.588E-01, -2.457E-01)	
3	(-5.678E-02, 8.290E-01)	(-5.678E-02, -8.290E-01)	(-1.741E-02, 6.501E-02)	(-1.741E-02, -6.501E-02)	
4	(-5.636E-02, -1.126E-01)	(-5.636E-02, 1.126E-01)	(7.758E-01, 4.234E-01)	(7.758E-01, -4.234E-01)	
5	(3.327E-01, -1.533E-01)	(3.327E-01, 1.533E-01)	(8.673E-01, 2.273E-01)	(8.673E-01, -2.273E-01)	
6	(-6.451E-02, 9.219E-01)	(-6.451E-02, -9.219E-01)	(-1.601E-02, 6.562E-02)	(-1.601E-02, -6.562E-02)	
7	(5.915E+00, -1.929E+00)	(5.915E+00, 1.929E+00)	(-9.212E-01, 1.738E+00)	(-9.212E-01, -1.738E+00)	
1	(-7.839E-01, 0.)	(-1.523E-01, 0.)	(7.304E-02, 0.)	(7.304E-02, 0.)	15
2	(-9.165E-02, 0.)	(-4.611E-02, 0.)	(2.168E-02, 0.)	(2.168E-02, 0.)	
3	(6.110E-01, 0.)	(4.380E-01, 0.)	(-2.032E-01, 0.)	(-2.032E-01, 0.)	
4	(-1.417E-03, 0.)	(-4.777E-02, 0.)	(2.222E-02, 0.)	(2.222E-02, 0.)	
5	(-1.911E-01, 0.)	(-1.407E-02, 0.)	(6.532E-03, 0.)	(6.532E-03, 0.)	
6	(1.274E+00, 0.)	(1.336E-01, 0.)	(-6.518E-02, 0.)	(-6.518E-02, 0.)	
7	(-5.733E+00, 0.)	(5.246E+00, 0.)	(-2.418E+00, 0.)	(-2.418E+00, 0.)	

OBSERVABILITY MATRIX (7 BY 15)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

1	(1.380E-02, -5.043E+01)	(1.380E-02, 5.043E+01)	(6.320E-05, -2.028E+01)	(6.320E-05, 2.028E+01)
2	(3.017E-03, -1.409E+02)	(3.017E-03, 1.409E+02)	(7.918E-03, 9.828E+01)	(7.918E-03, -9.828E+01)
3	(6.776E-02, -3.928E+01)	(6.776E-02, 3.928E+01)	(1.744E-03, -1.712E+02)	(1.744E-03, 1.712E+02)
4	(5.822E-03, 6.523E+01)	(5.822E-03, -6.523E+01)	(2.318E-04, 9.179E+01)	(2.318E-04, -9.179E+01)
5	(3.888E-02, -6.746E+01)	(3.888E-02, 6.746E+01)	(4.318E-04, 7.591E+01)	(4.318E-04, -7.591E+01)
6	(8.754E-01, 3.412E+01)	(8.754E-01, -3.412E+01)	(9.509E-01, 1.584E+02)	(9.509E-01, -1.584E+02)
7	(4.357E+00, -1.152E+01)	(4.357E+00, 1.152E+01)	(2.205E+00, 7.434E+01)	(2.205E+00, -7.434E+01)
8	(6.726E-03, -1.507E+02)	(6.726E-03, 1.507E+02)	(2.206E-02, -5.297E+01)	(2.206E-02, 5.297E+01)
9	(1.370E-03, 4.990E+01)	(1.370E-03, -4.990E+01)	(4.486E-03, -1.478E+02)	(4.486E-03, 1.478E+02)
10	(1.592E-02, 1.398E+02)	(1.592E-02, -1.398E+02)	(5.280E-02, -5.294E+01)	(5.280E-02, 5.294E+01)
11	(5.766E-04, 3.393E+01)	(5.766E-04, -3.393E+01)	(1.715E-03, 1.230E+02)	(1.715E-03, -1.230E+02)
12	(1.206E-01, 5.796E+01)	(1.206E-01, -5.796E+01)	(9.693E-02, 1.081E+02)	(9.693E-02, -1.081E+02)
13	(1.402E+00, 3.194E+01)	(1.402E+00, -3.194E+01)	(1.141E+00, 1.231E+01)	(1.141E+00, -1.231E+01)
14	(4.733E+00, 5.473E+01)	(4.733E+00, -5.473E+01)	(3.887E+00, -1.099E+02)	(3.887E+00, 1.039E+02)
15	(7.644E+00, -4.637E+01)	(7.644E+00, 4.637E+01)	(3.752E+02, 1.159E+02)	(3.752E+02, -1.159E+02)
16	(3.293E-01, -2.482E+01)	(3.293E-01, 2.482E+01)	(8.933E-01, 1.597E+01)	(8.933E-01, -1.597E+01)
17	(8.309E-01, 9.392E+01)	(8.309E-01, -9.392E+01)	(6.730E-02, 1.050E+02)	(6.730E-02, -1.050E+02)
18	(1.259E-01, 1.166E+02)	(1.259E-01, -1.166E+02)	(6.838E-01, 2.862E+01)	(6.838E-01, -2.862E+01)
19	(3.663E-01, -2.474E+01)	(3.663E-01, 2.474E+01)	(8.966E-01, 1.463E+01)	(8.966E-01, -1.463E+01)
20	(9.241E-01, 9.400E+01)	(9.241E-01, -9.400E+01)	(6.755E-02, 1.037E+02)	(6.755E-02, -1.037E+02)
21	(6.222E+00, -1.806E+01)	(6.222E+00, 1.806E+01)	(1.967E+00, 1.179E+02)	(1.967E+00, -1.179E+02)
22	(7.839E-01, 1.800E+02)	(7.839E-01, -1.800E+02)	(7.304E-02, 0.)	(7.304E-02, 0.)
23	(9.165E-02, 1.800E+02)	(9.165E-02, -1.800E+02)	(2.168E-02, 0.)	(2.168E-02, 0.)
24	(6.110E-01, 0.)	(6.110E-01, 0.)	(2.038E-01, 1.800E+02)	(2.038E-01, -1.800E+02)
25	(1.417E-03, 1.800E+02)	(1.417E-03, -1.800E+02)	(2.222E-02, 0.)	(2.222E-02, 0.)
26	(1.911E-01, 1.800E+02)	(1.911E-01, -1.800E+02)	(6.934E-03, 0.)	(6.934E-03, 0.)
27	(1.274E+00, 0.)	(1.274E+00, 0.)	(6.518E-02, 1.800E+02)	(6.518E-02, -1.800E+02)
28	(5.733E+00, 1.800E+02)	(5.733E+00, -1.800E+02)	(2.416E+00, 1.800E+02)	(2.416E+00, -1.800E+02)

THE C-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(1.101E-03, -1.293E-04)	(-3.008E-05, -2.405E-04)	(5.427E-03, 4.222E-04)	(-1.525E-04, 4.422E-04)
2	(1.101E-03, 1.293E-04)	(-3.008E-05, 2.405E-04)	(5.427E-03, -4.222E-04)	(-1.525E-04, -4.422E-04)
3	(-1.672E-09, 9.021E-09)	(-8.924E-09, -7.243E-09)	(1.613E-07, -1.950E-07)	(-2.835E-08, -1.811E-08)
4	(-1.672E-09, -9.021E-09)	(-8.924E-09, 7.243E-09)	(1.613E-07, 1.950E-07)	(-2.835E-08, 1.811E-08)
5	(-1.214E-02, 3.703E-03)	(1.204E-03, 2.289E-03)	(-2.658E-02, 1.404E-02)	(1.012E-03, -4.004E-04)
6	(-1.214E-02, -3.703E-03)	(1.204E-03, -2.289E-03)	(-2.658E-02, -1.404E-02)	(1.012E-03, 4.004E-04)
7	(-5.063E-02, 3.300E-02)	(7.548E-03, 9.169E-03)	(-1.212E-01, 7.891E-02)	(3.747E-03, 2.832E-03)
8	(-5.063E-02, -3.300E-02)	(7.548E-03, -9.169E-03)	(-1.212E-01, -7.891E-02)	(3.747E-03, -2.832E-03)
9	(-4.126E+00, 7.735E+00)	(2.582E-01, 2.757E-01)	(-9.231E-01, 2.363E-01)	(1.023E-01, -1.019E-01)
10	(-4.126E+00, -7.735E+00)	(2.582E-01, -2.757E-01)	(-9.231E-01, -2.363E-01)	(1.023E-01, 1.019E-01)
11	(5.556E+00, -4.464E+01)	(-1.070E-01, 5.290E-03)	(-5.354E-04, -8.052E-03)	(-1.044E-01, -1.808E-02)
12	(5.556E+00, 4.464E+01)	(-1.070E-01, -5.290E-03)	(-5.354E-04, 8.052E-03)	(-1.044E-01, 1.808E-02)
13	(-2.736E+00, 0.)	(-3.198E-01, 0.)	(2.132E+00, 0.)	(-4.945E-03, 0.)
14	(0.)	(0.)	(0.)	(0.)
15	(0.)	(0.)	(0.)	(0.)

	5	6	7
1	(2.867E-03, -1.260E-03)	(1.480E-02, 6.875E-02)	(2.961E-01, 1.866E-01)
2	(2.867E-03, 1.260E-03)	(1.480E-02, -6.875E-02)	(2.961E-01, -1.866E-01)
3	(-6.004E-06, -1.800E-06)	(4.086E-05, -1.318E-04)	(-3.052E-04, -8.353E-05)
4	(-6.004E-06, 1.800E-06)	(4.086E-05, 1.318E-04)	(-3.052E-04, 8.353E-05)
5	(1.593E-01, -1.627E-01)	(1.894E+00, 1.847E+00)	(6.600E+00, -6.022E+00)
6	(1.593E-01, 1.627E-01)	(1.894E+00, -1.847E+00)	(6.600E+00, 6.022E+00)
7	(-8.073E-03, 2.654E-01)	(-3.105E+00, -3.576E-01)	(3.419E-03, 1.065E+01)
8	(-8.073E-03, -2.654E-01)	(-3.105E+00, 3.576E-01)	(3.419E-03, -1.065E+01)
9	(2.867E-01, 3.071E-01)	(-1.027E+00, 2.617E-01)	(4.230E+00, -5.746E+00)
10	(2.867E-01, -3.071E-01)	(-1.027E+00, -2.617E-01)	(4.230E+00, 5.746E+00)
11	(-1.072E-01, 7.706E-03)	(-7.177E-04, -3.057E-03)	(3.744E-02, -2.322E-01)
12	(-1.072E-01, -7.706E-03)	(-7.177E-04, 3.057E-03)	(3.744E-02, 2.322E-01)
13	(-6.670E-01, 0.)	(4.446E+00, 0.)	(-2.001E+01, 0.)
14	(0.)	(0.)	(0.)
15	(0.)	(0.)	(0.)

CONTROL RESIDUE MATRIX (15 BY 7)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

ORIGINAL PAGE IS
OF POOR QUALITY

1	(1.109E-03, -6.698E+00)	1	(2.424E-04, -9.713E+01)	3	(5.444E-03, 4.448E+00)	4	(4.677E-04, 1.090E+02)
2	(1.109E-03, 6.698E+00)	2	(2.424E-04, 9.713E+01)	4	(5.444E-03, -4.448E+00)	5	(4.677E-04, -1.090E+02)
3	(9.175E-09, 1.005E+02)	3	(1.149E-08, -1.405E+02)	5	(2.531E-07, -5.040E+01)	6	(3.364E-08, -1.474E+02)
4	(9.175E-09, -1.005E+02)	4	(1.149E-08, 1.405E+02)	6	(2.531E-07, 5.040E+01)	7	(3.364E-08, 1.474E+02)
5	(1.270E-02, 1.630E+02)	5	(2.587E-03, 6.225E+01)	7	(3.005E-02, 1.521E+02)	8	(1.088E-03, -2.159E+01)
6	(1.270E-02, -1.630E+02)	6	(2.587E-03, -6.225E+01)	8	(3.005E-02, -1.521E+02)	9	(1.088E-03, 2.159E+01)
7	(6.043E-02, 1.469E+02)	7	(1.229E-02, 5.211E+01)	9	(1.444E-01, 1.459E+02)	10	(4.697E-03, -3.708E+01)
8	(6.043E-02, -1.469E+02)	8	(1.229E-02, -5.211E+01)	10	(1.444E-01, -1.459E+02)	11	(4.697E-03, 3.708E+01)
9	(8.767E+00, 1.181E+02)	9	(3.777E-01, 4.688E+01)	11	(9.529E-01, 1.656E+02)	12	(1.444E-01, 4.485E+01)
10	(8.767E+00, -1.181E+02)	10	(3.777E-01, -4.688E+01)	12	(9.529E-01, -1.656E+02)	13	(1.444E-01, -4.485E+01)
11	(4.499E+01, -8.291E+01)	11	(1.071E-01, 1.772E+02)	13	(8.070E-03, -9.380E+01)	14	(1.060E-01, -1.702E+02)
12	(4.499E+01, 8.291E+01)	12	(1.071E-01, -1.772E+02)	14	(8.070E-03, 9.380E+01)	15	(1.060E-01, 1.702E+02)
13	(2.736E+00, 1.800E+02)	13	(3.192E-01, 1.800E+02)	15	(2.132E+00, 0.)	16	(4.945E-03, 1.800E+02)
14	(0.)	14	(0.)	16	(0.)	17	(0.)
15	(0.)	15	(0.)	17	(0.)	18	(0.)
1	(3.131E-03, -2.373E+01)	5	(7.033E-02, 7.785E+01)	6	(3.500E-01, 3.221E+01)	7	(3.500E-01, -3.221E+01)
2	(3.131E-03, 2.373E+01)	6	(7.033E-02, -7.785E+01)	7	(3.500E-01, -3.221E+01)	8	(3.203E-04, -1.649E+02)
3	(6.268E-06, -1.633E+02)	7	(1.380E-04, -7.278E+01)	8	(3.203E-04, 1.649E+02)	9	(5.934E+00, -4.233E+01)
4	(6.268E-06, 1.633E+02)	8	(1.380E-04, 7.278E+01)	9	(5.934E+00, 4.233E+01)	10	(8.934E+00, -4.233E+01)
5	(2.277E-01, -4.561E+01)	9	(2.646E+00, 4.428E+01)	10	(8.934E+00, 4.233E+01)	11	(1.065E+01, 8.985E+01)
6	(2.277E-01, 4.561E+01)	10	(2.646E+00, -4.428E+01)	11	(1.065E+01, -8.985E+01)	12	(7.135E+00, 5.364E+01)
7	(2.555E-01, 9.174E+01)	11	(3.125E+00, -1.734E+02)	12	(1.065E+01, 8.985E+01)	13	(7.135E+00, -5.364E+01)
8	(2.555E-01, -9.174E+01)	12	(3.125E+00, 1.734E+02)	13	(1.065E+01, -8.985E+01)	14	(2.356E-01, -8.087E+01)
9	(4.201E-01, 4.697E+01)	13	(1.060E+00, 1.657E+02)	14	(2.356E-01, 8.087E+01)	15	(2.358E-01, 8.087E+01)
10	(4.201E-01, -4.697E+01)	14	(1.060E+00, -1.657E+02)	15	(2.358E-01, -8.087E+01)	16	(2.001E+01, 1.800E+02)
11	(1.075E-01, 1.755E+02)	15	(8.099E-03, 9.508E+01)	16	(2.001E+01, 1.800E+02)	17	(0.)
12	(1.075E-01, -1.755E+02)	16	(8.099E-03, -9.508E+01)	17	(0.)	18	(0.)
13	(6.670E-01, 1.800E+02)	17	(4.446E+00, 0.)	18	(0.)	19	(0.)
14	(0.)	18	(0.)	19	(0.)	20	(0.)
15	(0.)	19	(0.)	20	(0.)	21	(0.)

ORIGINAL PAGE IS
OF POOR QUALITY

THE D-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(-6.972E-05, -3.527E-05)	(-7.594E-06, 1.530E-05)	(-3.023E-04, -2.360E-04)	(2.617E-05, -2.004E-05)
2	(-6.972E-05, 3.527E-05)	(-7.594E-06, -1.530E-05)	(-3.023E-04, 2.360E-04)	(2.617E-05, 2.004E-05)
3	(-3.923E-10, 3.659E-10)	(-1.677E-10, -6.506E-10)	(1.436E-08, -3.559E-09)	(-7.031E-10, -1.837E-09)
4	(-3.923E-10, -3.659E-10)	(-1.677E-10, 6.506E-10)	(1.436E-08, 3.559E-09)	(-7.031E-10, 1.837E-09)
5	(-3.923E-05, 1.463E-05)	(4.428E-06, 7.304E-06)	(-8.478E-05, 5.161E-05)	(3.255E-06, -1.522E-06)
6	(-3.923E-05, -1.463E-05)	(-4.428E-06, -7.304E-06)	(8.478E-05, -5.161E-05)	(-3.255E-06, 1.522E-06)
7	(-1.724E-04, -2.154E-05)	(-1.432E-06, 3.530E-05)	(-4.125E-04, -5.176E-05)	(1.348E-05, 7.381E-07)
8	(-1.724E-04, 2.154E-05)	(1.432E-06, -3.530E-05)	(4.125E-04, 5.176E-05)	(-1.348E-05, -7.381E-07)
9	(-8.764E-03, 4.765E-03)	(7.261E-05, 4.236E-04)	(-1.025E-03, -3.532E-04)	(1.610E-04, -3.276E-05)
10	(-8.764E-03, -4.765E-03)	(-7.261E-05, -4.236E-04)	(1.025E-03, 3.532E-04)	(-1.610E-04, 3.276E-05)
11	(8.456E-03, -5.189E-04)	(-4.687E-06, -1.962E-05)	(1.472E-06, -3.782E-07)	(-2.717E-07, -1.996E-05)
12	(8.456E-03, 5.189E-04)	(4.687E-06, 1.962E-05)	(-1.472E-06, 3.782E-07)	(2.717E-07, 1.996E-05)
13	(0, 0)	(0, 0)	(0, 0)	(0, 0)
14	(-8.113E-02, 0)	(-2.456E-02, 0)	(2.333E-01, 0)	(-2.545E-02, 0)
15	(8.231E-02, 0)	(2.443E-02, 0)	(-2.297E-01, 0)	(2.504E-02, 0)
	5	6	7	
1	(-2.174E-04, -3.757E-05)	(1.806E-03, -4.614E-03)	(-1.013E-02, -2.248E-02)	
2	(-2.174E-04, 3.757E-05)	(1.806E-03, 4.614E-03)	(-1.013E-02, 2.248E-02)	
3	(-2.197E-07, -2.934E-07)	(6.505E-06, -4.777E-06)	(-1.163E-05, -1.468E-05)	
4	(-2.197E-07, 2.934E-07)	(6.505E-06, 4.777E-06)	(-1.163E-05, 1.468E-05)	
5	(4.923E-04, -5.681E-04)	(6.613E-03, 5.709E-03)	(2.055E-02, -2.117E-02)	
6	(4.923E-04, 5.681E-04)	(-6.613E-03, -5.709E-03)	(-2.055E-02, 2.117E-02)	
7	(-5.103E-04, 5.676E-04)	(-6.151E-03, 6.547E-03)	(-1.576E-02, 2.338E-02)	
8	(-5.103E-04, -5.676E-04)	(6.151E-03, -6.547E-03)	(1.576E-02, -2.338E-02)	
9	(8.007E-05, 4.713E-04)	(-1.140E-03, -3.945E-04)	(-4.207E-04, 8.105E-03)	
10	(8.007E-05, -4.713E-04)	(1.140E-03, 3.945E-04)	(4.207E-04, -8.105E-03)	
11	(-5.143E-06, -1.958E-05)	(1.469E-06, -4.125E-07)	(4.440E-05, -1.140E-06)	
12	(-5.143E-06, 1.958E-05)	(-1.469E-06, 4.125E-07)	(-4.440E-05, 1.140E-06)	
13	(0, 0)	(0, 0)	(0, 0)	
14	(-7.53E-03, 0)	(7.118E-02, 0)	(2.794E+00, 0)	
15	(7.614E-03, 0)	(-7.345E-02, 0)	(-2.724E+00, 0)	

DISTANCE RESIDUE MATRIX (15 BY 7)
OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

ORIGINAL PAGE 1
OF POOR QUALITY

1	(7.813E-05, -1.532E+02)	(1.708E-05, 1.164E+02)	(3.835E-04, -1.420E+02)	(3.296E-05, -3.744E+01)
2	(7.813E-05, 1.532E+02)	(1.708E-05, -1.164E+02)	(3.835E-04, 1.420E+02)	(3.296E-05, 3.744E+01)
3	(5.364E-10, 1.370E+02)	(6.720E-10, -1.044E+02)	(1.480E-08, -1.352E+01)	(1.967E-09, -1.109E+02)
4	(5.364E-10, -1.370E+02)	(6.720E-10, 1.044E+02)	(1.480E-08, 1.352E+01)	(1.967E-09, 1.109E+02)
5	(4.192E-05, -1.596E+02)	(8.541E-06, 5.878E+01)	(9.525E-05, 1.481E+02)	(3.594E-06, -2.506E+01)
6	(4.192E-05, 1.596E+02)	(8.541E-06, -5.878E+01)	(9.525E-05, -1.481E+02)	(3.594E-06, 2.506E+01)
7	(1.737E-04, -1.729E+02)	(3.533E-05, 9.232E+01)	(4.158E-04, -1.726E+02)	(1.350E-05, 3.134E+00)
8	(1.737E-04, 1.729E+02)	(3.533E-05, -9.232E+01)	(4.158E-04, 1.726E+02)	(1.350E-05, -3.134E+00)
9	(9.976E-03, 1.515E+02)	(4.298E-04, 8.027E+01)	(1.084E-03, -1.610E+02)	(1.643E-04, -1.150E+01)
10	(9.976E-03, -1.515E+02)	(4.298E-04, -8.027E+01)	(1.084E-03, 1.610E+02)	(1.643E-04, 1.150E+01)
11	(8.472E-03, -3.51E+00)	(2.017E-05, -1.034E+02)	(1.520E-06, -1.441E+01)	(1.995E-05, -9.078E+01)
12	(8.472E-03, 3.51E+00)	(2.017E-05, 1.034E+02)	(1.520E-06, 1.441E+01)	(1.995E-05, 9.078E+01)
13	(0. , 0.)	(0. , 0.)	(0. , 0.)	(0. , 0.)
14	(8.113E-02, 1.800E+02)	(2.456E-02, 1.800E+02)	(2.333E-01, 0.)	(2.545E-02, 1.800E+02)
15	(8.231E-02, 0.)	(2.443E-02, 0.)	(2.297E-01, 1.800E+02)	(2.504E-02, 0.)
1	(2.206E-04, -1.702E+02)	(4.955E-03, -6.862E+01)	(2.466E-02, -1.143E+02)	(2.466E-02, -1.143E+02)
2	(2.206E-04, 1.702E+02)	(4.955E-03, 6.862E+01)	(2.466E-02, 1.143E+02)	(2.466E-02, 1.143E+02)
3	(3.665E-07, -1.268E+02)	(8.071E-06, -3.629E+01)	(1.873E-05, -1.284E+02)	(1.873E-05, -1.284E+02)
4	(3.665E-07, 1.268E+02)	(8.071E-06, 3.629E+01)	(1.873E-05, 1.284E+02)	(1.873E-05, 1.284E+02)
5	(7.517E-04, -4.909E+01)	(8.736E-03, 4.081E+01)	(2.950E-02, -4.586E+01)	(2.950E-02, -4.586E+01)
6	(7.517E-04, 4.909E+01)	(8.736E-03, -4.081E+01)	(2.950E-02, 4.586E+01)	(2.950E-02, 4.586E+01)
7	(7.633E-04, 1.320E+02)	(8.983E-03, -1.332E+02)	(3.061E-02, 1.302E+02)	(3.061E-02, 1.302E+02)
8	(7.633E-04, -1.320E+02)	(8.983E-03, 1.332E+02)	(3.061E-02, -1.302E+02)	(3.061E-02, -1.302E+02)
9	(4.780E-04, 8.365E+01)	(1.206E-03, -1.609E+02)	(8.120E-03, 8.703E+01)	(8.120E-03, 8.703E+01)
10	(4.780E-04, -8.365E+01)	(1.206E-03, 1.609E+02)	(8.120E-03, -8.703E+01)	(8.120E-03, -8.703E+01)
11	(2.025E-05, -1.047E+02)	(1.525E-06, -1.555E+01)	(4.441E-05, -1.471E+00)	(4.441E-05, -1.471E+00)
12	(2.025E-05, 1.047E+02)	(1.525E-06, 1.555E+01)	(4.441E-05, 1.471E+00)	(4.441E-05, 1.471E+00)
13	(0. , 0.)	(0. , 0.)	(0. , 0.)	(0. , 0.)
14	(7.493E-03, 1.800E+02)	(7.118E-02, 0.)	(2.794E+00, 0.)	(2.794E+00, 0.)
15	(7.814E-03, 0.)	(7.345E-02, 1.800E+02)	(2.724E+00, 1.800E+02)	(2.724E+00, 1.800E+02)

THE B VECTOR (12 BY 1)

1 -2.884E-01
 2 -1.503E+01
 3 0.
 4 0.
 5 0.
 6 0.
 7 0.
 8 0.
 9 -2.230E+03
 10 -2.152E+02
 11 6.136E+02
 12 1.079E-01

THE C MATRIX (7 BY 12)

1	0.	0.	1.000E+00	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	1.000E+00	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	1.000E+00	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	-1.000E+00	0.	0.	1.000E+00	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	1.000E+00	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	1.000E+00	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	5.322E+00	-1.355E+00	1.423E-02	0.	1.285E-01	3.214E+00	0.	0.	0.	0.	0.	0.
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	3.456E-02	3.636E-02	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	2.640E-02	3.30E-02	3.456E-02	3.636E-02	0.	0.	0.	0.	0.	0.
7	6.701E-01	1.672E+00	-1.148E-03	0.	-5.621E-04	1.441E-04	0.	0.	0.	0.	0.	0.

THE D MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	-7.371E+02
10	0.	1.298E+03
11	0.	7.564E+02
12	0.	1.697E+00

THE E VECTOR (7 BY 1)

1
1
2
3
4
5
6
7

THE F MATRIX (7 BY 2)

	1	2
1	0.	0.
2	0.	0.
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	9.243E+00

THE GC VECTOR (15 BY 1)

1 0.
2 1.000E+00
3 5.621E-03
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

AP = -6.667E+00

THE GP VECTOR (15 BY 1)

1 1.000E+00
2 0.
3 0.
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

THE AU-SCALED MATRIX (12 BY 12)

	1	2	3	4	5	6
1	-1.208E+00	9.440E-01	-6.017E-01	0.	3.366E-01	-2.886E+00
2	-7.059E+00	-2.018E+00	-2.173E+00	0.	6.977E+00	3.782E+00
3	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.	0.
4	0.	1.000E+00	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	1.949E+01	3.519E+00	3.595E-02	0.	-4.074E+01	-1.254E+01
10	-4.290E+01	-5.385E-01	0.	0.	1.759E+01	-5.061E+02
11	-2.619E+01	-1.934E+00	1.279E-01	0.	9.151E+00	3.621E+01
12	-6.136E-02	-1.451E-03	0.	0.	2.235E-02	-1.069E-01

	7	8	9	10	11	12
1	-1.336E-01	1.195E-01	8.068E-03	-7.848E-02	-4.416E-03	1.375E-04
2	-5.995E+00	2.528E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	1.000E+00	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.	0.
7	0.	0.	0.	0.	1.000E+00	0.
8	0.	0.	0.	0.	0.	1.000E+00
9	-1.176E+01	1.516E+01	-8.726E-01	-2.216E-01	6.996E-01	-1.435E-01
10	6.295E+00	1.020E+01	2.939E-01	-8.596E+00	1.080E-01	1.017E-01
11	-5.593E+01	3.286E+00	-1.596E-01	3.553E+00	-2.785E-01	-2.410E-01
12	7.482E-03	-4.849E+02	-4.531E-04	2.674E-03	-2.908E-04	-4.080E-01

THE B-SCALED VECTOR (12 BY 1)

	1
1	-2.884E-01
2	-1.503E+01
3	0.
4	0.
5	0.
6	0.
7	0.
8	0.
9	5.886E+01
10	7.103E+00
11	-2.120E+01
12	-3.921E-03

 THE C-SCALED MATRIX (7 BY 12)

	1	2	3	4	5	6
1	0.	0.	9.490E+02	0.	0.	0.
2	0.	0.	0.	1.000E+00	0.	0.
3	0.	1.000E+00	0.	0.	0.	0.
4	-1.000E+00	0.	0.	1.000E+00	0.	0.
5	0.	0.	0.	1.000E+00	-1.000E+00	-1.000E+00
6	0.	1.000E+00	0.	0.	0.	0.
7	9.322E+00	-1.395E+00	1.350E+01	0.	-4.869E+00	-9.740E+01

	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	-1.000E+00	-1.000E+00	0.	0.	0.	0.
6	0.	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-1.939E+01	-4.599E+01	4.350E-02	-3.342E+00	1.627E-02	-3.964E-03

 THE D-SCALED MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	1.946E+01
10	0.	-4.283E+01
11	0.	-2.614E+01
12	0.	-6.170E-02

ORIGINAL PAGE IS
OF POOR QUALITY

THE AA MATRIX (15 BY 15)

	1	2	3	4	5	6	7	8
1	-6.667E+00	0.	0.	0.	0.	0.	0.	0.
2	0.	-9.400E+00	0.	0.	0.	0.	0.	0.
3	0.	-2.256E-02	-9.500E+00	0.	0.	0.	0.	0.
4	-2.884E-01	0.	-1.204E+00	-1.208E+00	9.440E-01	-6.017E-01	0.	3.386E-01
5	-1.503E+01	0.	-7.049E+00	-7.059E+00	-2.018E+00	-2.173E+00	0.	5.977E+00
6	0.	0.	0.	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.
7	0.	0.	0.	0.	1.000E+00	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.
12	5.886E+01	0.	1.946E+01	1.949E+01	3.519E+00	3.595E-02	0.	-4.074E+01
13	7.103E+00	0.	-4.283E+01	-4.290E+01	-5.385E-01	0.	0.	1.759E+01
14	-2.120E+01	0.	-2.614E+01	-2.619E+01	-1.934E+00	1.279E-01	0.	9.151E+00
15	-3.921E-03	0.	-6.170E-02	-6.138E-02	-1.451E-05	0.	0.	2.235E-02
	9	10	11	12	13	14	15	
9	0.	0.	0.	0.	0.	0.	0.	
10	0.	0.	0.	0.	0.	0.	0.	
11	0.	0.	0.	0.	0.	0.	0.	
12	-2.886E+00	-1.336E-01	1.195E-01	8.068E-03	-7.848E-02	-4.416E-03	1.375E-04	
13	3.782E+00	-5.995E+00	2.522E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02	
14	0.	0.	0.	0.	0.	0.	0.	
15	0.	0.	0.	0.	0.	0.	0.	
9	0.	0.	0.	0.	0.	0.	0.	
10	0.	0.	0.	0.	0.	0.	0.	
11	0.	0.	0.	0.	0.	0.	0.	
12	-1.254E+01	-1.176E+01	1.516E+01	-8.725E-01	-2.216E-01	6.596E-01	-1.435E-01	
13	-5.061E+02	6.295E+00	1.020E+01	2.939E-01	-8.596E+00	1.080E-01	1.017E-01	
14	3.621E+01	-5.593E+01	3.286E+00	-1.555E-01	3.963E+00	-2.785E-01	-2.410E-01	
15	-1.069E-01	7.482E-03	-4.849E+02	-4.531E-04	2.674E-05	-2.906E-04	-4.080E-01	

ORIGINAL PAGE IS
OF POOR QUALITY

THE CC MATRIX (7 BY 15)

	1	2	3	4	5
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	1.000E+00
4	0.	0.	0.	-1.000E+00	0.
5	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	1.000E+00
7	2.327E+00	0.	9.243E+00	9.322E+00	-1.395E+00
	6	7	8	9	10
1	9.490E-02	0.	0.	0.	0.
2	0.	1.000E+00	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	1.000E+00	0.	0.	0.
5	0.	1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
6	0.	0.	0.	0.	0.
7	1.350E+01	0.	-4.868E+00	-9.740E+01	-1.939E+01
	11	12	13	14	15
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.
5	-1.000E+00	0.	0.	0.	0.
6	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-4.599E+01	4.350E-02	-3.342E+00	1.627E-02	-3.964E-03

SPECTRAL DECOMPOSITION OF A-AUG

	REAL PART	IMAGINARY PART	FREQUENCY (HERTZ)	DAMPING RATIO	TIME CONST. (SEC/RAD)
1	-4.50357E+00	2.19996E+01	3.57396E+00	.20055195	2.22048E-01
3	-2.03840E-01	2.20195E+01	3.50466E+00	.00925587	4.50580E+00
5	-1.42382E+00	7.25867E+00	1.17742E+00	.19313770	6.59876E-01
7	2.09919E-01	6.56189E+00	1.11171E+00	-.03005119	-4.76397E+00
9	-7.98244E-01	9.03440E-01	1.91872E-01	.66213014	1.25275E+00
11	1.63109E-01	0.	0.	-1.00000000	-5.23782E+00
12	-1.46078E-01	0.	0.	1.00000000	6.84566E+00
13	-6.66667E+00	0.	0.	1.00000000	1.50000E-01
14	-9.50000E+00	0.	0.	1.00000000	1.05233E-01
15	-5.40000E+00	0.	0.	1.00000000	1.00333E-01


```

14 ( 6.069E-02, 2.411E-01) ( 6.069E-02, -2.411E-01) (-2.332E-02, 0. )
15 ( 1.666E-05, 5.111E-05) ( 1.666E-05, -5.111E-05) (-4.910E-06, 0. )

13
1 ( 1.788E-01, 0. )
2 ( 0. , 0. )
3 ( 0. , 0. )
4 (-4.688E-02, 0. )
5 ( 3.085E-01, 0. )
6 (-4.224E-04, 0. )
7 (-4.627E-02, 0. )
8 ( 1.368E-01, 0. )
9 ( 1.046E-02, 0. )
10 (-1.695E-02, 0. )
11 ( 7.096E-06, 0. )
12 (-9.121E-01, 0. )
13 (-6.973E-02, 0. )
14 ( 1.124E-01, 0. )
15 (-4.731E-05, 0. )

14
1 ( 0. , 0. )
2 ( 0. , 0. )
3 ( 3.191E-01, 0. )
4 ( 3.332E-03, 0. )
5 ( 2.943E-01, 0. )
6 (-1.017E-04, 0. )
7 (-1.098E-02, 0. )
8 (-.035E-02, 0. )
9 (-2.571E-02, 0. )
10 (-5.721E-02, 0. )
11 (-2.736E-05, 0. )
12 (-5.683E-01, 0. )
13 ( 2.442E-01, 0. )
14 ( 5.435E-01, 0. )
15 ( 2.600E-04, 0. )

15
1 ( 0. , 0. )
2 ( 8.157E-01, 0. )
3 (-1.840E-01, 0. )
4 (-1.782E-03, 0. )
5 (-1.707E-01, 0. )
6 ( 6.072E-05, 0. )
7 ( 1.816E-02, 0. )
8 (-4.123E-02, 0. )
9 ( 1.483E-02, 0. )
10 ( 3.341E-02, 0. )
11 ( 1.580E-05, 0. )
12 ( 3.875E-01, 0. )
13 (-1.234E-01, 0. )
14 (-5.140E-01, 0. )
15 (-1.485E-04, 0. )

15
1 ( -2.230E-02, 0. )
2 (-4.749E-06, 0. )

```

THE CON VECTOR (15 BY 1)

```

1 (-1.735E-02, 8.889E-02)
2 (-1.735E-02, -2.839E-02)
3 (-1.227E-05, -1.325E-04)
4 (-1.227E-05, 1.325E-04)
5 (-2.212E-01, -4.199E+00)
6 (-2.212E-01, 4.199E+00)
7 (-2.212E+00, -7.854E-01)
8 (-2.212E+00, 7.854E-01)
9 ( 4.423E-01, -4.821E-01)
10 ( 4.423E-01, 4.821E-01)
11 (-1.819E-01, -4.973E-30)
12 (-1.819E-01, -4.091E-30)
13 ( 5.593E+00, 0. )
14 ( 0. , 0. )
15 ( 0. , 0. )

```

CONTROLABILITY MATRIX (15 BY 1)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1 ( 9.057E-02, 1.010E+02)
2 ( 9.057E-02, -1.010E+02)
3 ( 1.335E-04, -9.527E+01)
4 ( 1.335E-04, 9.527E+01)
5 ( 4.205E+00, -9.302E+01)
6 ( 4.205E+00, 9.302E+01)
7 ( 2.827E+00, -1.631E+02)
8 ( 2.827E+00, 1.631E+02)
9 ( 5.539E-01, -4.750E+01)
10 ( 5.539E-01, 4.750E+01)
11 ( 1.816E-01, -1.800E+02)
12 ( 1.816E-01, 1.800E+02)
13 ( 5.593E+00, 0. )
14 ( 0. , 0. )
15 ( 0. , 0. )

```

THE DIST VECTOR (15 BY 1)

```

1
1 ( 3.946E-03, -3.982E-03 )
2 ( 3.946E-03, 3.982E-03 )
3 ( 4.683E-06, -7.066E-06 )
4 ( 4.683E-06, 7.066E-06 )
5 ( 6.105E-03, -6.940E-03 )
6 ( 6.105E-03, 6.940E-03 )
7 ( -5.885E-03, -1.404E-03 )
8 ( -5.885E-03, 1.404E-03 )
9 ( 3.373E-04, -1.583E-04 )
10 ( 3.373E-04, 1.583E-04 )
11 ( -3.132E-05, 6.774E-31 )
12 ( 3.756E-05, 4.795E-31 )
13 ( 0, 0 )
14 ( 7.245E-01, 0 )
15 ( 1.226E+00, 0 )

```

DISTURBABILITY MATRIX (15 BY 1)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEC.))

```

1
1 ( 5.605E-03, -4.526E+01 )
2 ( 5.605E-03, 4.526E+01 )
3 ( 8.477E-06, -5.647E+01 )
4 ( 8.477E-06, 5.647E+01 )
5 ( 9.243E-03, -4.866E+01 )
6 ( 9.243E-03, 4.866E+01 )
7 ( 6.050E-03, -1.666E+02 )
8 ( 6.050E-03, 1.666E+02 )
9 ( 3.726E-04, -2.515E+01 )
10 ( 3.726E-04, 2.515E+01 )
11 ( 3.132E-05, 1.600E+02 )
12 ( 3.759E-05, 7.314E-25 )
13 ( 0, 0 )
14 ( 7.245E-01, 0 )
15 ( 1.226E+00, 0 )

```


THE OBS MATRIX (7 BY 15)

1	(-4.342E-03, -1.328E-02)	1	(-4.342E-03, 1.328E-02)	3	(-7.286E-05, -1.261E-05)	4	(-7.286E-05, 1.261E-05)
2	(-2.899E-03, 9.832E-04)	2	(-2.899E-03, -9.832E-04)	4	(5.510E-05, -5.735E-05)	5	(5.510E-05, 5.735E-05)
3	(-8.575E-03, -6.820E-02)	3	(-8.575E-03, 6.820E-02)	5	(1.252E-03, 1.225E-03)	6	(1.252E-03, -1.225E-03)
4	(5.831E-03, 8.079E-04)	4	(5.831E-03, -8.079E-04)	6	(1.377E-04, -1.953E-04)	7	(1.377E-04, 1.953E-04)
5	(-2.229E-02, -3.401E-02)	5	(-2.229E-02, 3.401E-02)	7	(1.442E-02, -4.136E-02)	8	(1.442E-02, 4.136E-02)
6	(8.485E-01, -3.372E-01)	6	(8.485E-01, 3.372E-01)	8	(9.077E-01, 3.259E-01)	9	(9.077E-01, -3.259E-01)
7	(1.672E+00, -4.217E+00)	7	(1.672E+00, 4.217E+00)	9	(6.897E-01, -2.157E+00)	10	(6.897E-01, 2.157E+00)
1	(-1.053E-01, -9.218E-02)	5	(-1.052E-01, 9.218E-02)	6	(4.974E-02, -2.581E-03)	7	(4.974E-02, 2.581E-03)
2	(-1.265E-02, 1.312E-02)	2	(-1.265E-02, -1.312E-02)	7	(-1.260E-03, -5.824E-03)	8	(-1.260E-03, 5.824E-03)
3	(-7.713E-02, -1.106E-01)	3	(-7.713E-02, 1.106E-01)	8	(4.040E-02, -1.002E-02)	9	(4.040E-02, 1.002E-02)
4	(3.717E-03, -4.649E-03)	4	(3.717E-03, 4.649E-03)	9	(-1.695E-03, 5.406E-04)	10	(-1.695E-03, -5.406E-04)
5	(-1.485E-01, -3.582E-02)	5	(-1.485E-01, 3.582E-02)	10	(-1.620E-01, 1.135E-01)	11	(-1.620E-01, -1.135E-01)
6	(4.728E-01, -1.030E+00)	6	(4.728E-01, 1.030E+00)	11	(-8.267E-01, -1.107E+00)	12	(-8.267E-01, 1.107E+00)
7	(-1.740E+00, -1.196E+00)	7	(-1.740E+00, 1.196E+00)	12	(-2.256E+00, 1.791E+00)	13	(-2.256E+00, -1.791E+00)
1	(-1.730E+01, 1.005E+01)	9	(-1.730E+01, -1.005E+01)	10	(-1.685E+02, 0.)	11	(-1.685E+02, 0.)
2	(6.501E-02, 3.863E-01)	2	(6.501E-02, -3.863E-01)	11	(8.946E-01, 0.)	12	(8.946E-01, 0.)
3	(-4.009E-01, -2.496E-01)	3	(-4.009E-01, 2.496E-01)	12	(1.692E-01, 0.)	13	(1.692E-01, 0.)
4	(3.206E-01, -5.214E-02)	4	(3.206E-01, 5.214E-02)	13	(6.045E-01, 0.)	14	(6.045E-01, 0.)
5	(1.352E-01, 3.345E-01)	5	(1.352E-01, -3.345E-01)	14	(8.440E-01, 0.)	15	(8.440E-01, 0.)
6	(-4.101E-01, -1.448E-01)	6	(-4.101E-01, 1.448E-01)	15	(1.596E-01, 0.)	16	(1.596E-01, 0.)
7	(-4.582E+00, 9.525E+00)	7	(-4.582E+00, -9.525E+00)	16	(3.437E+00, 0.)	17	(3.437E+00, 0.)
1	(-4.008E-01, 0.)	13	(-9.649E-02, 0.)	14	(5.763E-02, 0.)	15	(5.763E-02, 0.)
2	(-4.627E-02, 0.)	2	(-3.098E-02, 0.)	15	(1.816E-02, 0.)	16	(1.816E-02, 0.)
3	(3.085E-01, 0.)	3	(2.943E-01, 0.)	16	(-1.707E-01, 0.)	17	(-1.707E-01, 0.)
4	(6.080E-04, 0.)	4	(-3.421E-02, 0.)	17	(1.994E-02, 0.)	18	(1.994E-02, 0.)
5	(-1.767E-01, 0.)	5	(-1.839E-02, 0.)	18	(1.114E-02, 0.)	19	(1.114E-02, 0.)
6	(1.178E+00, 0.)	6	(1.747E-01, 0.)	19	(-1.047E-01, 0.)	20	(-1.047E-01, 0.)
7	(-1.620E+00, 0.)	7	(5.004E+00, 0.)	20	(-2.893E+00, 0.)	21	(-2.893E+00, 0.)

OBSERVABILITY MATRIX (7 BY 15)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

1	1	1.397E-02, -1.081E+02)	1	1.397E-02, 1.081E+02)	3	7.394E-05, -1.702E+02)	4	7.394E-05, 1.702E+02)
2	2	3.061E-03, 1.613E+02)	2	3.061E-03, -1.613E+02)	4	7.953E-05, -4.614E+01)	4	7.953E-05, 4.614E+01)
3	3	5.874E-02, 9.717E+01)	3	5.874E-02, -9.717E+01)	1	1.751E-03, 4.439E+01)	1	1.751E-03, -4.439E+01)
4	4	5.887E-03, 7.886E+00)	4	5.887E-03, -7.886E+00)	2	2.390E-04, -5.481E+01)	2	2.390E-04, 5.481E+01)
5	5	4.066E-02, -1.232E+02)	5	4.066E-02, 1.232E+02)	4	4.380E-02, -7.078E+01)	4	4.380E-02, 7.078E+01)
6	6	9.131E-01, -2.164E+01)	6	9.131E-01, 2.164E+01)	9	9.644E-01, -1.975E+01)	9	9.644E-01, 1.975E+01)
7	7	4.537E+00, -6.837E+01)	7	4.537E+00, 6.837E+01)	2	2.303E+00, -7.257E+01)	2	2.303E+00, 7.257E+01)
1	5	1.399E-01, -1.388E+02)	5	1.399E-01, 1.388E+02)	1	4.980E-02, -2.971E+00)	8	4.980E-02, 2.971E+00)
2	2	1.823E-02, 1.340E+02)	2	1.823E-02, -1.340E+02)	5	5.959E-03, -1.022E+02)	5	5.959E-03, 1.022E+02)
3	3	1.348E-01, -1.249E+02)	3	1.348E-01, 1.249E+02)	4	4.162E-02, -1.393E+01)	4	4.162E-02, 1.393E+01)
4	4	5.952E-03, 5.135E+01)	4	5.952E-03, -5.135E+01)	1	1.779E-03, 1.623E+02)	1	1.779E-03, -1.623E+02)
5	5	1.532E-01, -1.665E+02)	5	1.532E-01, 1.665E+02)	1	1.970E-01, -1.450E+02)	1	1.970E-01, 1.450E+02)
6	6	1.133E+00, -6.534E+01)	6	1.133E+00, 6.534E+01)	1	1.382E+00, -1.267E+02)	1	1.382E+00, 1.267E+02)
7	7	2.111E+00, -1.455E+02)	7	2.111E+00, 1.455E+02)	2	2.680E+00, -1.4.5E+02)	2	2.680E+00, 1.4.5E+02)
1	9	2.001E+01, 1.498E+02)	9	2.001E+01, -1.498E+02)	1	1.536E+02, 0.	12	1.536E+02, 0.
2	2	3.917E-01, 8.045E+01)	2	3.917E-01, -8.045E+01)	8	8.613E-01, 0.	8	8.613E-01, 0.
3	3	4.722E-01, -1.481E+02)	3	4.722E-01, 1.481E+02)	1	1.250E-01, 1.800E+02)	1	1.250E-01, -1.800E+02)
4	4	3.249E-01, -9.237E+00)	4	3.249E-01, 9.237E+00)	1	1.227E+00, 0.	1	1.227E+00, 0.
5	5	3.608E-01, 6.799E+01)	5	3.608E-01, -6.799E+01)	9	9.222E-01, 0.	9	9.222E-01, 0.
6	6	4.350E-01, -1.605E+02)	6	4.350E-01, 1.605E+02)	1	1.547E-01, 1.800E+02)	1	1.547E-01, -1.800E+02)
7	7	1.075E+01, 1.176E+02)	7	1.075E+01, -1.176E+02)	3	3.437E+00, 0.	3	3.437E+00, 0.
1	13	4.008E-01, 1.800E+02)	13	4.008E-01, -1.800E+02)	15	5.763E-02, 0.	15	5.763E-02, 0.
2	2	4.627E-02, 1.800E+02)	2	4.627E-02, -1.800E+02)	1	1.816E-02, 0.	1	1.816E-02, 0.
3	3	3.085E-01, 0.	3	3.085E-01, 0.	1	1.707E-01, 1.800E+02)	1	1.707E-01, -1.800E+02)
4	4	6.030E-04, 0.	4	6.030E-04, 0.	1	1.994E-02, 0.	1	1.994E-02, 0.
5	5	1.767E-01, 1.800E+02)	5	1.767E-01, -1.800E+02)	1	1.114E-02, 0.	1	1.114E-02, 0.
6	6	1.178E+00, 0.	6	1.178E+00, 0.	1	1.047E-01, 1.800E+02)	1	1.047E-01, -1.800E+02)
7	7	1.620E+00, 1.800E+02)	7	1.620E+00, -1.800E+02)	2	2.893E+00, 1.800E+02)	2	2.893E+00, -1.800E+02)

 ** RESIDUE MATRICES **

 *** ROWS CORRESPOND TO MODES ***
 *** COLUMNS CORRESPOND TO OUTPUTS ***

 IMPULSE RESIDUE MATRIX FOR CONTROL - 1

ORIGINAL PAGE IS
OF POOR QUALITY

THE C-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(1.256E-03, -1.555E-04)	(-3.709E-05, -2.747E-04)	(6.211E-03, 4.212E-04)	(-1.730E-04, 5.043E-04)
2	(1.256E-03, 1.555E-04)	(-3.709E-05, 2.747E-04)	(6.211E-03, -4.212E-04)	(-1.730E-04, -5.043E-04)
3	(-7.824E-10, 9.838E-09)	(-8.251E-09, -6.620E-09)	(1.475E-07, -1.814E-07)	(-2.765E-08, -1.591E-08)
4	(-7.824E-10, -9.838E-09)	(-8.251E-09, 6.620E-09)	(1.475E-07, 1.814E-07)	(-2.765E-08, 1.591E-08)
5	(-3.638E-01, 4.621E-01)	(5.768E-02, 5.024E-02)	(-4.474E-01, 3.484E-01)	(1.870E-02, -1.664E-02)
6	(-3.638E-01, -4.621E-01)	(5.768E-02, -5.024E-02)	(-4.474E-01, -3.484E-01)	(1.870E-02, 1.664E-02)
7	(-1.371E-01, -3.205E-02)	(-1.152E-03, 1.681E-02)	(-1.176E-01, 4.514E-03)	(5.028E-03, -1.372E-04)
8	(-1.371E-01, 3.205E-02)	(-1.152E-03, -1.681E-02)	(-1.176E-01, -4.514E-03)	(5.028E-03, 1.372E-04)
9	(-2.798E+00, 1.278E+01)	(2.149E-01, 1.393E-01)	(-2.974E-01, 8.298E-02)	(1.165E-01, -1.778E-01)
10	(-2.798E+00, -1.278E+01)	(2.149E-01, -1.393E-01)	(-2.974E-01, -8.298E-02)	(1.165E-01, 1.778E-01)
11	(3.055E+01, 8.377E-28)	(-1.625E-01, -4.450E-30)	(-3.073E-02, -8.415E-31)	(-1.098E-01, -3.002E-30)
12	(-2.175E+01, -6.283E-26)	(-1.220E-01, -3.524E-30)	(1.782E-02, 5.147E-31)	(-1.738E-01, -5.019E-30)
13	(-2.242E+00, 0.)	(-2.588E-01, 0.)	(1.725E+00, 0.)	(3.400E-03, 0.)
14	(0.)	(0.)	(0.)	(0.)
15	(0.)	(0.)	(0.)	(0.)
	5	6	7	
1	(3.410E-03, -1.391E-03)	(1.525E-02, 8.127E-02)	(3.459E-01, 2.218E-01)	
2	(3.410E-03, 1.391E-03)	(1.525E-02, -8.127E-02)	(3.459E-01, -2.218E-01)	
3	(-5.674E-06, -1.409E-06)	(3.218E-05, -1.246E-04)	(3.005E-04, -6.472E-05)	
4	(-5.674E-06, 1.409E-06)	(3.218E-05, 1.246E-04)	(3.005E-04, 6.472E-05)	
5	(-1.175E-01, 6.333E-01)	(-4.429E+00, -1.759E+00)	(-4.639E+00, 7.572E+00)	
6	(-1.175E-01, -6.333E-01)	(-4.429E+00, 1.759E+00)	(-4.639E+00, -7.572E+00)	
7	(5.291E-01, -1.811E-01)	(1.376E+00, 3.056E+00)	(7.535E+00, 3.094E+00)	
8	(5.291E-01, 1.811E-01)	(1.376E+00, -3.056E+00)	(7.535E+00, -3.094E+00)	
9	(2.210E-01, 8.259E-02)	(-2.510E-01, 1.337E-01)	(2.391E+00, 6.611E+00)	
10	(2.210E-01, -8.259E-02)	(-2.510E-01, -1.337E-01)	(2.391E+00, -6.611E+00)	
11	(-1.305E-01, -4.197E-20)	(-2.298E-02, -7.527E-31)	(-8.415E-01, -1.705E-29)	
12	(-1.305E-01, 4.197E-20)	(-2.298E-02, 7.527E-31)	(-8.415E-01, 1.705E-29)	
13	(-9.652E-01, 0.)	(6.586E+00, 0.)	(-9.061E+00, 0.)	
14	(0.)	(0.)	(0.)	
15	(0.)	(0.)	(0.)	

CONTROL RESIDUE MATRIX (15 BY 7)
OUTPUT FOR: (MAGNITUDE , PHASE(DEG.))

ORIGINAL PAGE IS
OF POOR QUALITY

1	(1.265E-03, -7.055E+00)	1	(2.772E-04, -9.769E+01)	2	(6.225E-03, 3.879E+00)	3	(5.332E-04, 1.089E+02)	4	(5.332E-04, 1.089E+02)
2	(1.265E-03, 7.055E+00)	2	(2.772E-04, 9.769E+01)	3	(6.225E-03, -3.879E+00)	4	(5.332E-04, -1.089E+02)		
3	(9.889E-09, 9.455E+01)	3	(1.062E-08, -1.414E+02)	4	(2.336E-07, -5.089E+01)	5	(3.190E-08, 1.501E+02)		
4	(9.889E-09, -9.455E+01)	4	(1.062E-08, 1.414E+02)	5	(2.336E-07, 5.089E+01)	6	(3.190E-08, -1.501E+02)		
5	(5.881E-01, 1.282E+02)	5	(7.664E-02, 4.096E+01)	6	(5.670E-01, 1.421E+02)	7	(2.503E-02, -4.167E+01)		
6	(5.881E-01, -1.282E+02)	6	(7.664E-02, -4.096E+01)	7	(5.670E-01, -1.421E+02)	8	(2.503E-02, 4.167E+01)		
7	(1.408E-01, -1.668E+02)	7	(1.685E-02, 9.322E+01)	8	(1.177E-01, -1.778E+02)	9	(5.030E-03, -1.563E+00)		
8	(1.408E-01, 1.668E+02)	8	(1.685E-02, -9.322E+01)	9	(1.177E-01, 1.778E+02)	10	(5.030E-03, 1.563E+00)		
9	(1.308E+01, 1.023E+02)	9	(2.562E-01, 3.295E+01)	10	(3.088E-01, 1.644E+02)	11	(2.124E-01, -5.673E+01)		
10	(1.308E+01, -1.023E+02)	10	(2.562E-01, -3.295E+01)	11	(3.088E-01, -1.644E+02)	12	(2.124E-01, 5.673E+01)		
11	(3.059E+01, 1.569E+27)	11	(1.625E-01, -1.800E+02)	12	(3.073E-02, -1.800E+02)	13	(1.098E-01, -1.800E+02)		
12	(2.175E+01, -1.800E+02)	12	(1.220E-01, 1.800E+02)	13	(1.762E-02, 1.655E-27)	14	(1.738E-01, -1.800E+02)		
13	(2.242E+00, 1.800E+02)	13	(2.528E-01, 1.800E+02)	14	(1.725E+00, 0.)	15	(3.400E-03, 0.)		
14	(0.)	14	(0.)	15	(0.)		(0.)		
15	(0.)	15	(0.)		(0.)		(0.)		
1	(3.682E-03, -2.220E+01)	5	(8.269E-02, 7.937E+01)	6	(4.109E-01, 3.267E+01)	7	(4.109E-01, -3.267E+01)		
2	(3.682E-03, 2.220E+01)	6	(8.269E-02, -7.937E+01)	7	(4.109E-01, -3.267E+01)	8	(3.074E-04, -1.678E+02)		
3	(5.846E-06, -1.661E+02)	7	(1.287E-04, -7.553E+01)	8	(3.074E-04, 1.678E+02)	9	(3.074E-04, -1.678E+02)		
4	(5.846E-06, 1.661E+02)	8	(1.287E-04, 7.553E+01)	9	(3.074E-04, 1.678E+02)	10	(8.878E+00, 1.215E+02)		
5	(6.441E-01, 1.005E+02)	9	(4.765E+00, -1.594E+02)	10	(8.878E+00, -1.215E+02)	11	(8.144E+00, -2.233E+01)		
6	(6.441E-01, -1.005E+02)	10	(4.765E+00, 1.594E+02)	11	(8.878E+00, 1.215E+02)	12	(8.144E+00, 2.233E+01)		
7	(5.582E-01, 1.890E+01)	11	(3.906E+00, 6.936E+01)	12	(3.906E+00, -6.936E+01)	13	(7.029E+00, 1.011E+01)		
8	(5.582E-01, -1.890E+01)	12	(3.906E+00, -6.936E+01)	13	(7.029E+00, -1.011E+01)	14	(7.029E+00, 7.011E+01)		
9	(2.352E-01, 2.049E+01)	13	(2.844E-01, 1.520E+02)	14	(2.844E-01, -1.520E+02)	15	(6.241E-01, -1.800E+02)		
10	(2.352E-01, -2.049E+01)	14	(2.844E-01, -1.520E+02)	15	(6.241E-01, 1.800E+02)				
11	(1.533E-01, -1.800E+02)								
12	(1.306E-01, -1.800E+02)								
13	(9.882E-01, 1.800E+02)								
14	(0.)								
15	(0.)								

THE D-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(-7.000E-05, -3.511E-05)	(-7.523E-06, 1.542E-05)	(-3.054E-04, -2.349E-04)	(2.623E-05, -2.003E-05)
2	(-7.000E-05, 3.511E-05)	(-7.523E-06, -1.542E-05)	(-3.054E-04, 2.349E-04)	(2.623E-05, 2.003E-05)
3	(-4.303E-10, 4.558E-10)	(-1.472E-10, -6.580E-10)	(1.452E-08, -3.107E-09)	(-7.351E-10, -1.888E-09)
4	(-4.303E-10, -4.558E-10)	(-1.472E-10, 6.580E-10)	(1.452E-08, 3.107E-09)	(-7.351E-10, 1.888E-09)
5	(-1.282E-03, 1.671E-04)	(1.377E-05, 1.675E-04)	(-1.238E-03, -1.399E-04)	(5.496E-05, 2.582E-06)
6	(-1.282E-03, -1.671E-04)	(1.377E-05, -1.675E-04)	(-1.238E-03, 1.399E-04)	(5.496E-05, -2.582E-06)
7	(-2.963E-04, -5.64E-05)	(-7.615E-07, 3.604E-05)	(-2.518E-04, 2.249E-06)	(1.073E-05, -8.018E-07)
8	(-2.963E-04, 5.64E-05)	(-7.615E-07, -3.604E-05)	(-2.518E-04, -2.249E-06)	(1.073E-05, 8.018E-07)
9	(-4.244E-03, 6.128E-03)	(8.308E-05, 1.200E-04)	(-1.747E-04, -2.072E-05)	(9.990E-05, 6.835E-05)
10	(-4.244E-03, -6.128E-03)	(8.308E-05, -1.200E-04)	(-1.747E-04, 2.072E-05)	(9.990E-05, -6.835E-05)
11	(5.277E-03, -1.141E-29)	(-2.903E-05, 6.061E-31)	(-5.300E-06, 1.146E-31)	(-1.693E-05, 4.094E-31)
12	(5.277E-03, 7.370E-29)	(3.238E-05, 4.133E-31)	(-4.730E-06, -6.033E-32)	(4.612E-05, 5.888E-31)
13	(0.0, 0.0)	(0.0, 0.0)	(0.0, 0.0)	(0.0, 0.0)
14	(-6.991E-02, 0.0)	(-2.245E-02, 0.0)	(2.132E-01, 0.0)	(-2.486E-02, 0.0)
15	(7.065E-02, 0.0)	(2.226E-02, 0.0)	(-2.092E-01, 0.0)	(2.445E-02, 0.0)

	5	6	7
1	(-2.233E-04, -4.542E-05)	(2.005E-03, -4.709E-03)	(-1.019E-02, -2.330E-02)
2	(-2.233E-04, 4.542E-05)	(2.005E-03, 4.709E-03)	(-1.019E-02, 2.330E-02)
3	(-2.247E-07, -2.956E-07)	(6.554E-06, -4.888E-06)	(-1.230E-05, -1.516E-05)
4	(-2.247E-07, 2.956E-07)	(6.554E-06, 4.888E-06)	(-1.230E-05, 1.516E-05)
5	(-1.158E-03, 3.146E-04)	(-4.260E-03, -9.569E-03)	(-1.892E-02, 4.777E-03)
6	(-1.158E-03, -3.146E-04)	(-4.260E-03, 9.569E-03)	(-1.892E-02, -4.777E-03)
7	(1.113E-03, -4.407E-04)	(3.310E-03, 7.675E-03)	(1.579E-02, -7.375E-03)
8	(1.113E-03, 4.407E-04)	(3.310E-03, -7.675E-03)	(1.579E-02, 7.375E-03)
9	(9.857E-05, 9.141E-05)	(-1.613E-04, 1.608E-05)	(-1.723E-04, 4.002E-03)
10	(9.857E-05, -9.141E-05)	(-1.613E-04, -1.608E-05)	(-1.723E-04, -4.002E-03)
11	(-2.644E-05, 5.717E-31)	(-4.399E-06, 1.081E-31)	(-1.077E-04, 2.328E-30)
12	(-2.644E-05, -5.717E-31)	(-4.399E-06, -1.081E-31)	(-1.077E-04, -2.328E-30)
13	(0.0, 0.0)	(0.0, 0.0)	(0.0, 0.0)
14	(-1.332E-02, 0.0)	(1.266E-01, 0.0)	(3.626E+00, 0.0)
15	(1.365E-02, 0.0)	(-1.263E-01, 0.0)	(-3.547E+00, 0.0)

DISTURBANCE RESIDUE MATRIX (15 BY 7)
 OUTPUT FOR: (MAGNITUDE , PHASE(DEG.))

1	(7.832E-05, -1.534E+02)	1	(1.716E-05, 1.160E+02)	2	(3.853E-04, -1.424E+02)	3	(3.300E-05, -3.737E+01)	4	(3.300E-05, -3.737E+01)
2	(7.832E-05, 1.534E+02)		(1.716E-05, -1.160E+02)		(3.853E-04, 1.424E+02)		(3.300E-05, 3.737E+01)		(3.300E-05, 3.737E+01)
3	(6.268E-10, 1.334E+02)		(6.742E-10, -1.026E+02)		(1.485E-08, -1.208E+01)		(2.026E-09, -1.113E+02)		(2.026E-09, -1.113E+02)
4	(6.268E-10, -1.334E+02)		(6.742E-10, 1.026E+02)		(1.485E-08, 1.208E+01)		(2.026E-09, 1.113E+02)		(2.026E-09, 1.113E+02)
5	(1.293E-03, 1.726E+02)		(1.685E-04, 8.531E+01)		(1.246E-03, -1.736E+02)		(5.502E-05, 2.690E+00)		(5.502E-05, 2.690E+00)
6	(1.293E-03, -1.726E+02)		(1.685E-04, -8.531E+01)		(1.246E-03, 1.736E+02)		(5.502E-05, -2.690E+00)		(5.502E-05, -2.690E+00)
7	(3.013E-04, -1.696E+02)		(3.605E-05, 9.121E+01)		(2.518E-04, 1.795E+02)		(1.076E-05, -4.273E+00)		(1.076E-05, -4.273E+00)
8	(3.013E-04, 1.696E+02)		(3.605E-05, -9.121E+01)		(2.518E-04, -1.795E+02)		(1.076E-05, 4.273E+00)		(1.076E-05, 4.273E+00)
9	(7.454E-03, 1.247E+02)		(1.460E-04, 5.530E+01)		(1.760E-04, -1.732E+02)		(1.210E-04, -3.438E+01)		(1.210E-04, -3.438E+01)
10	(7.454E-03, -1.247E+02)		(1.460E-04, -5.530E+01)		(1.760E-04, 1.732E+02)		(1.210E-04, 3.438E+01)		(1.210E-04, 3.438E+01)
11	(5.277E-03, -1.239E-24)		(2.803E-05, 1.900E+02)		(5.300E-06, 1.800E+02)		(1.892E-05, 1.800E+02)		(1.892E-05, 1.800E+02)
12	(5.277E-03, 1.239E-24)		(2.803E-05, -1.900E+02)		(5.300E-06, -1.800E+02)		(1.892E-05, -1.800E+02)		(1.892E-05, -1.800E+02)
13	(0, 0)		(0, 0)		(0, 0)		(0, 0)		(0, 0)
14	(6.991E-02, 1.800E+02)		(2.245E-02, 1.800E+02)		(2.132E-01, 0)		(2.486E-02, 1.800E+02)		(2.486E-02, 1.800E+02)
15	(7.065E-02, 0)		(2.226E-02, 0)		(2.093E-01, 1.800E+02)		(2.445E-02, 0)		(2.445E-02, 0)
1	(2.279E-04, -1.685E+02)	5	(5.118E-03, -6.693E+01)	6	(2.543E-02, -1.136E+02)	7	(2.543E-02, -1.136E+02)		
2	(2.279E-04, 1.685E+02)		(5.118E-03, 6.693E+01)		(2.543E-02, 1.136E+02)		(2.543E-02, 1.136E+02)		
3	(3.713E-07, -1.272E+02)		(8.176E-06, -3.672E+01)		(1.952E-05, -1.290E+02)		(1.952E-05, -1.290E+02)		
4	(3.713E-07, 1.272E+02)		(8.176E-06, 3.672E+01)		(1.952E-05, 1.290E+02)		(1.952E-05, 1.290E+02)		
5	(1.416E-03, 1.449E+02)		(1.047E-02, -1.140E+02)		(1.952E-02, -1.658E+02)		(1.952E-02, -1.658E+02)		
6	(1.416E-03, -1.449E+02)		(1.047E-02, 1.140E+02)		(1.952E-02, 1.658E+02)		(1.952E-02, 1.658E+02)		
7	(1.197E-03, -2.161E+01)		(8.359E-03, 6.667E+01)		(1.743E-02, -2.504E+01)		(1.743E-02, -2.504E+01)		
8	(1.197E-03, 2.161E+01)		(8.359E-03, -6.667E+01)		(1.743E-02, 2.504E+01)		(1.743E-02, 2.504E+01)		
9	(1.344E-04, 4.284E+01)		(1.621E-04, 1.743E+02)		(4.005E-03, 9.247E+01)		(4.005E-03, 9.247E+01)		
10	(1.344E-04, -4.284E+01)		(1.621E-04, -1.743E+02)		(4.005E-03, -9.247E+01)		(4.005E-03, -9.247E+01)		
11	(2.644E-05, 1.800E+02)		(4.999E-06, 1.300E+02)		(1.077E-04, 1.800E+02)		(1.077E-04, 1.800E+02)		
12	(2.644E-05, -1.800E+02)		(4.999E-06, -1.300E+02)		(1.077E-04, -1.800E+02)		(1.077E-04, -1.800E+02)		
13	(0, 0)		(0, 0)		(0, 0)		(0, 0)		
14	(1.332E-02, 1.800E+02)		(1.266E-01, 0)		(3.62EE+00, 0)		(3.62EE+00, 0)		
15	(1.365E-02, 0)		(1.283E-01, 1.800E+02)		(3.547E+00, 1.800E+02)		(3.547E+00, 1.800E+02)		

CONFIGURATION 7

THE AU MATRIX (12 BY 12)

	1	2	3	4	5	6
1	-1.208E+00	9.440E-01	-6.340E-04	0.	-8.940E-03	9.525E-02
2	-7.059E+00	-2.018E+00	-2.290E-03	0.	-1.842E-01	-1.248E-01
3	-2.500E+01	0.	-2.500E-02	-3.220E+01	0.	0.
4	0.	1.000E+00	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	-7.383E+02	-1.333E+02	-1.435E-03	0.	-9.777E+01	-1.568E+01
10	1.300E+03	1.633E+01	0.	0.	1.407E+01	-5.061E+02
11	7.577E+02	5.595E+01	-3.900E-03	0.	6.990E+00	3.458E+01
12	1.688E+00	3.990E-02	0.	0.	1.623E-02	9.700E-02

	7	8	9	10	11	12
1	4.618E-03	-4.346E-03	-2.130E-04	2.590E-03	1.526E-04	-4.998E-06
2	2.072E-01	-9.171E-02	-7.438E-03	4.972E-02	6.963E-03	-2.004E-03
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	1.000E+00	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.	0.
7	0.	0.	0.	0.	1.000E+00	0.
8	0.	0.	0.	0.	0.	1.000E+00
9	-1.540E+01	2.088E+01	-1.005E+00	-2.770E-01	9.159E-01	-1.977E-01
10	6.593E+00	1.124E+01	2.351E-01	-8.596E+00	1.131E-01	1.120E-01
11	-1.030E+02	3.457E+00	-1.219E-01	3.784E+00	-3.913E-01	-2.535E-01
12	7.112E-03	-4.849E+02	-3.290E-04	2.427E-03	-2.764E-04	-4.080E-01

THE AG MATRIX (2 BY 2)

	1	2
1	-9.400E+00	0.
2	-2.256E-02	-9.500E+00

THE B VECTOR (12 BY 1)

1
-2.884E-01
2
-1.503E+01
3
0.
4
0.
5
0.
6
0.
7
0.
8
0.
9
-2.230E+03
10
-2.152E+02
11
6.136E+02
12
1.079E-01

THE C MATRIX (7 BY 12)

	1	2	3	4	5	6
1	0.	0.	1.000E+00	0.	0.	0.
2	0.	0.	0.	1.000E+00	0.	0.
3	0.	1.000E+00	0.	0.	0.	0.
4	-1.000E+00	0.	0.	1.000E+00	0.	0.
5	0.	0.	0.	1.000E+00	2.640E-02	3.300E-02
6	0.	1.000E+00	0.	0.	0.	0.
7	9.322E+00	-1.395E+00	1.423E-02	0.	7.473E-01	3.214E+00
	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	3.456E-02	3.636E-02	0.	0.	0.	0.
6	0.	0.	0.640E-02	3.300E-02	3.456E-02	3.636E-02
7	9.333E-01	1.672E+00	2.922E-04	1.103E-01	6.902E-05	1.441E-04

THE D MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	-7.371E+02
10	0.	1.298E+03
11	0.	7.564E+02
12	0.	1.697E+00

THE E VECTOR (7 BY 1)

	1
1	0.
2	0.
3	0.
4	0.
5	0.
6	0.
7	2.327E+00

THE F MATRIX (7 BY 2)

	1	2
1	0.	0.
2	0.	0.
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	9.243E+00

THE CG VECTOR (15 BY 1)

1
0.
2 1.000E+00
3 5.621E-03
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

AP = -6.667E+00

THE GP VECTOR (15 BY 1)

1
1.000E+00
2 0.
3 0.
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

ORIGINAL PAGE IS
OF POOR QUALITY

THE AU-SCALED MATRIX (12 BY 12)

	1	2	3	4	5	6
1	-1.208E+00	9.440E-01	-6.017E-01	0.	3.386E-01	-2.886E+00
2	-7.059E+00	-2.018E+00	-2.173E+00	0.	6.977E+00	3.782E+00
3	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.	0.
4	0.	1.000E+00	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	1.949E+01	3.519E+00	3.595E-02	0.	-9.777E+01	-1.254E+01
10	-4.290E+01	-5.389E-01	0.	0.	1.759E+01	-5.061E+02
11	-2.619E+01	-1.934E+00	1.279E-01	0.	9.151E+00	3.621E+01
12	-6.138E-02	-1.451E-03	0.	0.	2.235E-02	-1.069E-01

	7	8	9	10	11	12
1	-1.336E-01	1.195E-01	8.068E-03	-7.848E-02	-4.416E-01	1.375E-04
2	-5.995E+00	2.522E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	1.000E+00	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.	0.
7	0.	0.	0.	0.	1.000E+00	0.
8	0.	0.	0.	0.	0.	1.000E+00
9	-1.176E+01	1.516E+01	-1.005E+00	-2.216E-01	6.996E-01	-1.433E-01
10	6.295E+00	1.020E+01	2.939E-01	-8.596E+00	1.080E-01	1.017E-01
11	-1.030E+02	3.286E+00	-1.596E-01	3.963E+00	-3.913E-01	-2.410E-01
12	7.482E-03	-4.849E+02	-4.531E-04	2.674E-03	-2.508E-04	-4.080E-01

THE B-SCALED VECTOR (12 BY 1)

	1
1	-2.804E-01
2	-1.503E+01
3	0.
4	0.
5	0.
6	0.
7	0.
8	0.
9	5.886E+01
10	7.103E+00
11	-2.120E+01
12	-3.921E-03

THE C-SCALED MATRIX (7 BY 12)

	1	2	3	4	5	6
1	0.	0.	9.490E+02	0.	0.	0.
2	0.	0.	0.	1.000E+00	0.	0.
3	0.	1.000E+00	0.	0.	0.	0.
4	-1.000E+00	0.	0.	1.000E+00	0.	0.
5	0.	0.	0.	1.000E+00	-1.000E+00	-1.000E+00
6	0.	1.000E+00	0.	0.	0.	0.
7	9.322E+00	-1.395E+00	1.350E+01	0.	-2.831E+01	-9.740E+01

	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	-1.000E+00	-1.000E+00	0.	0.	0.	0.
6	0.	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-2.701E+01	-4.599E+01	-1.107E-02	-3.342E+00	-1.997E-03	-3.964E-03

THE D-SCALED MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	1.946E+01
10	0.	-4.283E+01
11	0.	-2.614E+01
12	0.	-6.170E-02

THE AA MATRIX (15 BY 15)

1	2	3	4	5	6	7	8
-6.667E+00	0.	0.	0.	0.	0.	0.	0.
0.	-9.400E+00	0.	0.	0.	0.	0.	0.
0.	-2.256E-02	-9.500E+00	0.	0.	0.	0.	0.
-2.884E-01	0.	-1.204E+00	-1.208E+00	9.440E-01	-6.017E-01	0.	3.386E-01
-1.503E+01	0.	-7.049E+00	-7.059E+00	-2.018E+00	-2.173E+00	0.	6.977E+00
0.	0.	0.	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.
0.	0.	0.	0.	1.000E+00	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.
5.886E+01	0.	1.946E+01	1.949E+01	3.519E+00	3.595E-02	0.	-9.777E+01
7.103E+00	0.	-4.283E+01	-4.290E+01	-5.389E-01	0.	0.	1.759E+01
-2.120E+01	0.	-2.614E+01	-2.619E+01	-1.934E+00	1.279E-01	0.	9.151E+00
-3.921E-03	0.	-6.170E-02	-6.138E-02	-1.451E-03	0.	0.	2.235E-02
9	10	11	12	13	14	15	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
-2.886E+00	-1.336E-01	1.195E-01	8.068E-03	-7.848E-02	-4.416E-03	1.375E-04	
3.782E+00	-5.995E+00	2.522E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	1.000E+00	0.	0.	0.	
0.	0.	0.	0.	1.000E+00	0.	0.	
0.	0.	0.	0.	0.	1.000E+00	0.	
0.	0.	0.	0.	0.	0.	1.000E+00	
-1.254E+01	-1.176E+01	1.516E+01	-1.005E+00	-2.216E-01	6.996E-01	-1.435E-01	
-5.061E+02	6.295E+00	1.020E+01	2.939E-01	-8.596E+00	1.080E-01	1.017E-01	
3.621E+01	-1.030E+02	3.286E+00	-1.596E-01	3.963E+00	-3.913E-01	-2.410E-01	
-1.069E-01	7.482E-03	-4.849E+02	-4.531E-04	2.674E-03	-2.908E-04	-4.080E-01	

THE CC MATRIX (7 BY 15)

	1	2	3	4	5
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	1.000E+00
4	0.	0.	-1.000E+00	0.	0.
5	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	1.000E+00
7	2.327E+00	0.	9.243E+00	9.322E+00	-1.395E+00

	6	7	8	9	10
1	9.490E+02	0.	0.	0.	0.
2	0.	1.000E+00	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	1.000E+00	0.	0.	0.
5	0.	1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
6	0.	0.	0.	0.	0.
7	1.350E+01	0.	-2.831E+01	-9.740E+01	-2.701E+01

	11	12	13	14	15
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.
5	-1.000E+00	0.	0.	0.	0.
6	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-4.599E+01	-1.107E-02	-3.342E+00	-1.997E-03	-3.964E-03

SPECTRAL DECOMPOSITION OF A-AUG

	REAL PART	IMAGINARY PART	FREQUENCY (HERTZ)	DAMPING RATIO	TIME CONST. (SEC/RAD)
1	-4.50562E+00	2.20005E+01	3.57417E+00	.20063183	2.21945E-01
3	-2.03840E-01	2.20195E+01	3.50466E+00	.00925685	4.90581E+00
5	1.82831E-01	9.92558E+00	1.57997E+00	-.01841702	-5.46594E+00
7	-1.17337E+00	1.01712E+01	1.62954E+00	.11460140	8.52246E-01
9	-1.12898E+00	2.02507E+00	3.69003E-01	.48694112	8.85756E-01
11	3.12706E-03	6.10897E-02	9.73545E-03	-.05112115	-3.19789E+02
13	-6.66667E+00	0.	0.	1.00000000	1.50000E-01
14	-9.50000E+00	0.	0.	1.00000000	1.05263E-01
15	-9.40000E+00	0.	0.	1.00000000	1.06383E-01

[illegible]

14	(1.890E-01, -1.254E-01)	(1.890E-01, 1.254E-01)	(-3.738E-03, -1.857E-03)	(-3.738E-03, 1.857E-03)
15	(6.528E-05, -5.718E-05)	(6.528E-05, 5.718E-05)	(-1.463E-06, -7.226E-07)	(-1.463E-06, 7.226E-07)
13				
1	(2.584E-01, 0.	(0.	(0.	
2	(0.	(0.	(8.687E-01, 0.	
3	(0.	(3.959E-01, 0.	(-1.960E-01, 0.	
4	(-7.826E-02, 0.	(2.283E-03, 0.	(-9.260E-04, 0.	
5	(5.271E-01, 0.	(3.896E-01, 0.	(-1.944E-01, 0.	
6	(-7.143E-04, 0.	(-1.405E-04, 0.	(7.226E-05, 0.	
7	(-7.907E-02, 0.	(-4.101E-02, 0.	(2.069E-02, 0.	
8	(1.162E-01, 0.	(5.870E-02, 0.	(-2.938E-02, 0.	
9	(1.339E-02, 0.	(-3.242E-02, 0.	(1.606E-02, 0.	
10	(-2.162E-02, 0.	(-5.535E-02, 0.	(2.765E-02, 0.	
11	(7.786E-06, 0.	(-3.474E-05, 0.	(1.723E-05, 0.	
12	(-7.747E-01, 0.	(-5.576E-01, 0.	(2.762E-01, 0.	
13	(-8.926E-02, 0.	(3.080E-01, 0.	(-1.510E-01, 0.	
14	(1.442E-01, 0.	(5.258E-01, 0.	(-2.602E-01, 0.	
15	(-5.191E-05, 0.	(3.300E-04, 0.	(-1.620E-04, 0.	
14				
	(0.	(0.	(0.687E-01, 0.	
	(0.	(3.959E-01, 0.	(-1.960E-01, 0.	
	(-7.826E-02, 0.	(2.283E-03, 0.	(-9.260E-04, 0.	
	(5.271E-01, 0.	(3.896E-01, 0.	(-1.944E-01, 0.	
	(-7.143E-04, 0.	(-1.405E-04, 0.	(7.226E-05, 0.	
	(-7.907E-02, 0.	(-4.101E-02, 0.	(2.069E-02, 0.	
	(1.162E-01, 0.	(5.870E-02, 0.	(-2.938E-02, 0.	
	(1.339E-02, 0.	(-3.242E-02, 0.	(1.606E-02, 0.	
	(-2.162E-02, 0.	(-5.535E-02, 0.	(2.765E-02, 0.	
	(7.786E-06, 0.	(-3.474E-05, 0.	(1.723E-05, 0.	
	(-7.747E-01, 0.	(-5.576E-01, 0.	(2.762E-01, 0.	
	(-8.926E-02, 0.	(3.080E-01, 0.	(-1.510E-01, 0.	
	(1.442E-01, 0.	(5.258E-01, 0.	(-2.602E-01, 0.	
	(-5.191E-05, 0.	(3.300E-04, 0.	(-1.620E-04, 0.	
15				
	(0.	(0.	(0.	
	(0.	(0.	(8.687E-01, 0.	
	(0.	(3.959E-01, 0.	(-1.960E-01, 0.	
	(-7.826E-02, 0.	(2.283E-03, 0.	(-9.260E-04, 0.	
	(5.271E-01, 0.	(3.896E-01, 0.	(-1.944E-01, 0.	
	(-7.143E-04, 0.	(-1.405E-04, 0.	(7.226E-05, 0.	
	(-7.907E-02, 0.	(-4.101E-02, 0.	(2.069E-02, 0.	
	(1.162E-01, 0.	(5.870E-02, 0.	(-2.938E-02, 0.	
	(1.339E-02, 0.	(-3.242E-02, 0.	(1.606E-02, 0.	
	(-2.162E-02, 0.	(-5.535E-02, 0.	(2.765E-02, 0.	
	(7.786E-06, 0.	(-3.474E-05, 0.	(1.723E-05, 0.	
	(-7.747E-01, 0.	(-5.576E-01, 0.	(2.762E-01, 0.	
	(-8.926E-02, 0.	(3.080E-01, 0.	(-1.510E-01, 0.	
	(1.442E-01, 0.	(5.258E-01, 0.	(-2.602E-01, 0.	
	(-5.191E-05, 0.	(3.300E-04, 0.	(-1.620E-04, 0.	

THE CON VECTOR (15 BY 1)

```

1 (-3.302E-02, -7.740E-02)
2 (-3.302E-02, 7.740E-02)
3 ( 1.193E-04, 7.478E-05)
4 ( 1.193E-04, -7.478E-05)
5 ( 9.414E-01, -1.220E+00)
6 ( 9.414E-01, 1.220E+00)
7 (-2.114E+00, -1.453E+00)
8 (-2.114E+00, 1.453E+00)
9 ( 6.603E-01, 8.241E-01)
10 ( 6.603E-01, -8.241E-01)
11 (-1.206E-01, 5.459E-02)
12 (-1.206E-01, -5.459E-02)
13 ( 3.870E+00, 0. )
14 ( 0. , 0. )
15 ( 0. , 0. )

```

CONTROLABILITY MATRIX (15 BY 1)
OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1 ( 8.415E-02, -1.131E+02)
2 ( 8.415E-02, 1.131E+02)
3 ( 1.408E-04, 3.208E+01)
4 ( 1.408E-04, -3.208E+01)
5 ( 1.541E+00, -5.234E+01)
6 ( 1.541E+00, 5.234E+01)
7 ( 2.565E+00, -1.455E+02)
8 ( 2.565E+00, 1.455E+02)
9 ( 1.056E+00, 5.130E+01)
10 ( 1.056E+00, -5.130E+01)
11 ( 1.324E-01, 1.557E+02)
12 ( 1.324E-01, -1.557E+02)
13 ( 3.870E+00, 0. )
14 ( 0. , 0. )
15 ( 0. , 0. )

```

THE DIST VECTOR (15 BY 1)

```

1 (-1.033E-03, 5.539E-03)
2 (-1.033E-03, -5.539E-03)
3 ( 2.973E-06, 7.948E-06)
4 ( 2.973E-06, -7.948E-06)
5 ( 1.749E-03, -1.265E-03)
6 ( 1.749E-03, 4.265E-03)
7 (-7.574E-04, -6.623E-03)
8 (-7.574E-04, 6.623E-03)
9 ( 1.319E-04, 1.120E-03)
10 ( 1.319E-04, -1.120E-03)
11 (-1.116E-05, -1.566E-05)
12 (-1.116E-05, 1.566E-05)
13 ( 0, 0 )
14 ( 5.841E-01, 0 )
15 ( 1.151E+00, 0 )

```

DISTURBABILITY MATRIX (15 BY 1)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1 ( 5.635E-03, 1.006E+02)
2 ( 5.635E-03, -1.006E+02)
3 ( 8.486E-06, 6.949E+01)
4 ( 8.486E-06, -6.949E+01)
5 ( 4.610E-03, -6.770E+01)
6 ( 4.610E-03, 6.770E+01)
7 ( 6.666E-03, -9.652E+01)
8 ( 6.666E-03, 9.652E+01)
9 ( 1.128E-03, 8.328E+01)
10 ( 1.128E-03, -8.328E+01)
11 ( 1.923E-05, -1.255E+02)
12 ( 1.923E-05, 1.255E+02)
13 ( 0, 0 )
14 ( 5.841E-01, 0 )
15 ( 1.151E+00, 0 )

```

ORIGINAL PAGE IS
OF POOR QUALITY

THE OBS		MATRIX (7 BY 15)						
		1	2	3	4	5	6	7
1	(-3.865E-03, 1.334E-02)	(-3.865E-03, -1.334E-02)	(2.747E-05, 6.307E-05)	(2.747E-05, -6.307E-05)				
2	(2.927E-03, 8.186E-04)	(2.927E-03, 8.186E-04)	(-7.826E-05, -9.415E-06)	(-7.826E-05, 9.415E-06)				
3	(-3.120E-02, 6.071E-02)	(-3.120E-02, 6.071E-02)	(2.233E-04, -1.721E-03)	(2.233E-04, 1.721E-03)				
4	(-4.351E-03, 3.920E-03)	(-4.351E-03, 3.920E-03)	(-2.348E-04, 2.200E-06)	(-2.348E-04, -2.200E-06)				
5	(-2.334E-05, 3.990E-02)	(-2.334E-05, 3.990E-02)	(-4.166E-02, 1.237E-02)	(-4.166E-02, -1.237E-02)				
6	(-8.778E-01, -1.803E-01)	(-8.778E-01, -1.803E-01)	(-2.638E-01, 9.198E-01)	(-2.638E-01, -9.198E-01)				
7	(-3.664E+00, 2.532E+00)	(-3.664E+00, 2.532E+00)	(-2.135E+00, 7.024E-01)	(-2.135E+00, -7.024E-01)				
		8	9	10	11	12	13	14
1	(-1.091E-02, -2.114E-02)	(-1.091E-02, 2.114E-02)	(9.249E-03, -4.260E-02)	(9.249E-03, 4.260E-02)				
2	(-3.235E-03, 2.476E-03)	(-3.235E-03, -2.476E-03)	(-7.666E-03, -1.286E-03)	(-7.666E-03, 1.286E-03)				
3	(-2.517E-02, -3.166E-02)	(-2.517E-02, 3.166E-02)	(2.207E-02, -7.647E-02)	(2.207E-02, 7.647E-02)				
4	(9.016E-04, 1.156E-03)	(9.016E-04, -1.156E-03)	(-6.346E-04, 2.778E-03)	(-6.346E-04, -2.778E-03)				
5	(1.187E-01, 5.256E-02)	(1.187E-01, -5.256E-02)	(-5.879E-02, 7.531E-02)	(-5.879E-02, -7.531E-02)				
6	(-4.999E-01, 1.187E+00)	(-4.999E-01, -1.187E+00)	(8.350E-01, -5.096E-01)	(8.350E-01, 5.096E-01)				
7	(3.465E+00, 1.723E+00)	(3.465E+00, -1.723E+00)	(-1.737E+00, -2.247E+00)	(-1.737E+00, 2.247E+00)				
		15	16	17	18	19	20	21
1	(3.488E+00, 7.874E+00)	(3.488E+00, -7.874E+00)	(-2.164E+02, 3.754E+02)	(-2.164E+02, -3.754E+02)				
2	(3.385E-01, -3.172E-02)	(3.385E-01, 3.172E-02)	(8.021E-01, 2.605E-01)	(8.021E-01, -2.605E-01)				
3	(-3.180E-01, 7.214E-01)	(-3.180E-01, -7.214E-01)	(-1.340E-02, 4.981E-02)	(-1.340E-02, -4.981E-02)				
4	(-1.728E-02, 1.378E-01)	(-1.728E-02, -1.378E-01)	(6.744E-01, 4.895E-01)	(6.744E-01, -4.895E-01)				
5	(3.782E-01, -3.610E-02)	(3.782E-01, 3.610E-02)	(8.155E-01, 2.360E-01)	(8.155E-01, -2.360E-01)				
6	(-3.539E-01, 8.066E-01)	(-3.539E-01, -8.066E-01)	(-1.186E-02, 5.056E-02)	(-1.186E-02, -5.056E-02)				
7	(5.679E+00, 6.168E-01)	(5.679E+00, -6.168E-01)	(-8.261E-01, 1.259E+00)	(-8.261E-01, -1.259E+00)				
		22	23	24	25	26	27	28
1	(-6.779E-01, 0.)	(-1.333E-01, 0.)	(6.858E-02, 0.)	(6.858E-02, 0.)				
2	(-7.907E-02, 0.)	(-4.101E-02, 0.)	(2.069E-02, 0.)	(2.069E-02, 0.)				
3	(5.271E-01, 0.)	(3.896E-01, 0.)	(-1.944E-01, 0.)	(-1.944E-01, 0.)				
4	(-8.042E-04, 0.)	(-4.329E-02, 0.)	(2.161E-02, 0.)	(2.161E-02, 0.)				
5	(-1.870E-01, 0.)	(-1.189E-02, 0.)	(5.311E-03, 0.)	(5.311E-03, 0.)				
6	(1.277E+00, 0.)	(1.130E-01, 0.)	(-5.932E-02, 0.)	(-5.932E-02, 0.)				
7	(-4.576E+00, 0.)	(5.103E+00, 0.)	(-2.527E+00, 0.)	(-2.527E+00, 0.)				

OBSERVABILITY MATRIX (7 BY 15)
OUTPUT FORM: (MAGNITUDE , PHASE(DEC.))

ORIGINAL PAGE IS
OF POOR QUALITY

```

1 ( 1.389E-02, 1.062E+02) ( 1.389E-02, -1.062E+02) ( 6.879E-05, 6.647E+01) ( 6.879E-05, -6.647E+01)
2 ( 3.035E-03, 1.562E+01) ( 3.035E-03, -1.562E+01) ( 7.882E-05, -1.731E+02) ( 7.882E-05, 1.731E+02)
3 ( 6.826E-02, 1.172E+02) ( 6.826E-02, -1.172E+02) ( 1.736E-03, -8.261E+01) ( 1.736E-03, 8.261E+01)
4 ( 5.856E-03, -1.380E+02) ( 5.856E-03, 1.380E+02) ( 2.348E-04, -1.795E+02) ( 2.348E-04, 1.795E+02)
5 ( 3.990E-02, 9.003E+01) ( 3.990E-02, -9.003E+01) ( 4.346E-02, 1.635E+02) ( 4.346E-02, -1.635E+02)
6 ( 8.961E-01, -1.684E+02) ( 8.961E-01, 1.684E+02) ( 9.569E-01, -1.060E+02) ( 9.569E-01, 1.060E+02)
7 ( 4.454E+00, 1.454E+02) ( 4.454E+00, -1.454E+02) ( 2.248E+00, 1.618E+02) ( 2.248E+00, -1.618E+02)

1 ( 2.379E-02, -1.173E+02) ( 2.379E-02, 1.173E+02) ( 4.359E-02, -7.775E+01) ( 4.359E-02, 7.775E+01)
2 ( 4.074E-03, 1.426E+02) ( 4.074E-03, -1.426E+02) ( 7.773E-03, -1.705E+02) ( 7.773E-03, 1.705E+02)
3 ( 4.044E-02, -1.285E+02) ( 4.044E-02, 1.285E+02) ( 7.959E-02, -7.390E+01) ( 7.959E-02, 7.390E+01)
4 ( 1.466E-03, 5.206E+01) ( 1.466E-03, -5.206E+01) ( 2.849E-03, 1.029E+02) ( 2.849E-03, -1.029E+02)
5 ( 1.298E-01, 2.389E+01) ( 1.298E-01, -2.389E+01) ( 9.554E-02, -1.280E+02) ( 9.554E-02, 1.280E+02)
6 ( 1.288E+00, 1.128E+02) ( 1.288E+00, -1.128E+02) ( 9.782E-01, -3.139E+01) ( 9.782E-01, 3.139E+01)
7 ( 3.870E+00, 2.644E+01) ( 3.870E+00, -2.644E+01) ( 2.840E+00, -1.277E+02) ( 2.840E+00, 1.277E+02)

1 ( 8.612E+00, 6.611E+01) ( 8.612E+00, -6.611E+01) ( 4.333E+02, 1.200E+02) ( 4.333E+02, -1.200E+02)
2 ( 3.400E-01, -5.353E+00) ( 3.400E-01, 5.353E+00) ( 8.433E-01, -1.799E+02) ( 8.433E-01, 1.799E+02)
3 ( 7.884E-01, 1.738E+02) ( 7.884E-01, -1.738E+02) ( 5.155E-02, 1.051E+02) ( 5.155E-02, -1.051E+02)
4 ( 1.389E-01, -9.715E+01) ( 1.389E-01, 9.715E+01) ( 8.333E-01, 3.598E+01) ( 8.333E-01, -3.598E+01)
5 ( 3.799E-01, -5.452E+00) ( 3.799E-01, 5.452E+00) ( 8.490E-01, 1.614E+01) ( 8.490E-01, -1.614E+01)
6 ( 8.808E-01, 1.137E+02) ( 8.808E-01, -1.137E+02) ( 5.193E-02, 1.032E+02) ( 5.193E-02, -1.032E+02)
7 ( 6.708E+00, 5.276E+00) ( 6.708E+00, -5.276E+00) ( 1.506E+00, 1.233E+02) ( 1.506E+00, -1.233E+02)

1 ( 6.779E-01, 1.800E+02) ( 6.779E-01, -1.800E+02) ( 6.858E-02, 0. ) ( 6.858E-02, 0. )
2 ( 7.907E-02, 1.800E+02) ( 7.907E-02, -1.800E+02) ( 2.069E-02, 0. ) ( 2.069E-02, 0. )
3 ( 5.271E-01, 0. ) ( 5.271E-01, -0. ) ( 1.944E-01, 1.800E+02) ( 1.944E-01, -1.800E+02)
4 ( 8.042E-04, 1.800E+02) ( 8.042E-04, -1.800E+02) ( 2.161E-02, 0. ) ( 2.161E-02, 0. )
5 ( 1.870E-01, 1.800E+02) ( 1.870E-01, -1.800E+02) ( 6.311E-03, 0. ) ( 6.311E-03, 0. )
6 ( 1.247E+00, 0. ) ( 1.247E+00, -0. ) ( 5.932E-02, 1.800E+02) ( 5.932E-02, -1.800E+02)
7 ( 4.576E+00, 1.800E+02) ( 4.576E+00, -1.800E+02) ( 2.527E+00, 1.800E+02) ( 2.527E+00, -1.800E+02)

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*****
** RESIDUE MATRICES **
*****
*** ROWS CORRESPOND TO MODES ***
*** COLUMNS CORRESPOND TO OUTPUTS ***
*****

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IMPULSE RESIDUE MATRIX FOR CONTROL - 1

THE C-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(1.160E-03, -1.413E-04)	(-3.329E-05, -2.536E-04)	(5.729E-03, 4.103E-04)	(-1.597E-04, 4.662E-04)
2	(1.160E-03, 1.413E-04)	(-3.329E-05, 2.536E-04)	(5.729E-03, -4.103E-04)	(-1.597E-04, -4.662E-04)
3	(-1.440E-09, 9.578E-09)	(-8.631E-09, -6.975E-09)	(1.553E-07, -1.886E-07)	(-2.817E-08, -1.730E-08)
4	(-1.440E-09, -9.578E-09)	(-8.631E-09, 6.975E-09)	(1.553E-07, 1.886E-07)	(-2.817E-08, 1.730E-08)
5	(-3.606E-02, -6.591E-03)	(-2.527E-05, 6.276E-03)	(-6.230E-02, 8.967E-04)	(2.259E-03, -1.098E-05)
6	(-3.606E-02, 6.591E-03)	(-2.527E-05, -6.276E-03)	(-6.230E-02, -8.967E-04)	(2.259E-03, 1.098E-05)
7	(-8.146E-02, 7.660E-02)	(1.434E-02, 1.386E-02)	(-1.578E-01, 1.296E-01)	(5.378E-03, -4.949E-03)
8	(-8.146E-02, -7.660E-02)	(1.434E-02, -1.386E-02)	(-1.578E-01, -1.296E-01)	(5.378E-03, 4.949E-03)
9	(-4.186E+00, 8.074E+00)	(2.497E-01, 2.580E-01)	(-8.044E-01, 2.143E-01)	(1.022E-01, -1.052E-01)
10	(-4.186E+00, -8.074E+00)	(2.497E-01, -2.580E-01)	(-8.044E-01, -2.143E-01)	(1.022E-01, 1.052E-01)
11	(5.614E+00, -5.710E+01)	(-1.110E-01, 1.235E-02)	(-1.102E-03, 6.741E-03)	(-1.081E-01, -2.225E-02)
12	(5.614E+00, 5.710E+01)	(-1.110E-01, -1.235E-02)	(-1.102E-03, -6.741E-03)	(-1.081E-01, 2.225E-02)
13	(-2.623E+00, 0.)	(-3.060E-01, 0.)	(2.040E+00, 0.)	(-3.112E-03, 0.)
14	(0.)	(0.)	(0.)	(0.)
15	(0.)	(0.)	(0.)	(0.)
	5	6	7	
1	(3.089E-03, -1.316E-03)	(1.503E-02, -7.390E-02)	(3.170E-01, 2.000E-01)	
2	(3.089E-03, 1.316E-03)	(1.503E-02, 7.390E-02)	(3.170E-01, -2.000E-01)	
3	(-5.894E-06, -1.640E-06)	(3.731E-05, -1.295E-04)	(-3.072E-04, -7.587E-05)	
4	(-5.894E-06, 1.640E-06)	(3.731E-05, 1.295E-04)	(-3.072E-04, 7.587E-05)	
5	(1.758E-01, -9.525E-02)	(9.775E-01, 1.728E+00)	(5.364E+00, -2.604E+00)	
6	(1.758E-01, 9.525E-02)	(9.775E-01, -1.728E+00)	(5.364E+00, 2.604E+00)	
7	(1.482E-02, 2.446E-01)	(-2.506E+00, 1.364E-01)	(4.045E-01, -7.274E+00)	
8	(1.482E-02, -2.446E-01)	(-2.506E+00, -1.364E-01)	(4.045E-01, 7.274E+00)	
9	(2.795E-01, 2.878E-01)	(-8.984E-01, 3.410E-01)	(3.902E+00, 5.912E+00)	
10	(2.795E-01, -2.878E-01)	(-8.984E-01, -3.410E-01)	(3.902E+00, -5.912E+00)	
11	(-1.113E-01, 1.605E-02)	(-1.329E-03, -6.747E-03)	(3.092E-02, -1.970E-01)	
12	(-1.113E-01, -1.605E-02)	(-1.329E-03, 6.747E-03)	(3.092E-02, 1.970E-01)	
13	(-7.238E-01, 0.)	(4.825E+00, 0.)	(-1.771E+01, 0.)	
14	(0.)	(0.)	(0.)	
15	(0.)	(0.)	(0.)	

CONTROL RESIDUE MATRIX (15 BY 7)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

1	(1.169E-03, -6.945E+00)	1	(2.558E-04, -9.748E+01)	3	(5.744E-03, 4.096E+00)	4	(4.928E-04, 1.089E+02)
2	(1.169E-03, 6.945E+00)	2	(2.558E-04, 9.748E+01)		(5.744E-03, -4.096E+00)		(4.928E-04, -1.089E+02)
3	(9.695E-09, 9.855E+01)		(1.110E-08, -1.411E+02)		(2.444E-07, -5.053E+01)		(3.306E-08, -1.485E+02)
4	(9.695E-09, -9.855E+01)		(1.110E-08, 1.411E+02)		(2.444E-07, 5.053E+01)		(3.306E-08, 1.485E+02)
5	(3.666E-02, -1.696E+02)		(6.277E-03, 9.023E+01)		(6.231E-02, 1.792E+02)		(2.259E-03, -2.783E+01)
6	(3.666E-02, 1.696E+02)		(6.277E-03, -9.023E+01)		(6.231E-02, -1.792E+02)		(2.259E-03, 2.783E+01)
7	(1.118E-01, 1.368E+02)		(1.994E-02, 4.403E+01)		(2.042E-01, 1.406E+02)		(7.309E-03, -4.262E+01)
8	(1.118E-01, -1.368E+02)		(1.994E-02, -4.403E+01)		(2.042E-01, -1.406E+02)		(7.309E-03, 4.262E+01)
9	(9.095E+00, 1.174E+02)		(3.591E-01, 4.594E+01)		(8.325E-01, 1.651E+02)		(1.467E-01, -4.585E+01)
10	(9.095E+00, -1.174E+02)		(3.591E-01, -4.594E+01)		(8.325E-01, -1.651E+02)		(1.467E-01, 4.585E+01)
11	(5.738E+01, -8.438E+01)		(1.117E-01, 1.736E+02)		(6.831E-03, -9.925E+01)		(1.103E-01, -1.684E+02)
12	(5.738E+01, 8.438E+01)		(1.117E-01, -1.736E+02)		(6.831E-03, 9.925E+01)		(1.103E-01, 1.684E+02)
13	(2.623E+00, 1.800E+02)		(3.060E-01, 1.800E+02)		(2.040E+00, 0.)		(3.112E-03, 1.800E+02)
14	(0. , 0.)		(0. , 0.)		(0. , 0.)		(0. , 0.)
15	(0. , 0.)		(0. , 0.)		(0. , 0.)		(0. , 0.)
1	(3.358E-03, -2.307E+01)	5	(7.541E-02, 7.851E+01)	7	(3.748E-01, 3.226E+01)		
2	(3.358E-03, 2.307E+01)		(7.541E-02, -7.851E+01)		(3.748E-01, -3.226E+01)		
3	(6.118E-06, -1.645E+02)		(1.347E-04, -7.392E+01)		(3.165E-04, -1.661E+02)		
4	(6.118E-06, 1.645E+02)		(1.347E-04, 7.392E+01)		(3.165E-04, 1.661E+02)		
5	(2.000E-01, -2.845E+01)		(1.985E+00, 6.050E+01)		(5.963E+00, -2.590E+01)		
6	(2.000E-01, 2.845E+01)		(1.985E+00, -6.050E+01)		(5.963E+00, 2.590E+01)		
7	(2.451E-01, 8.653E+01)		(2.509E+00, -1.769E+02)		(7.286E+00, 8.682E+01)		
8	(2.451E-01, -8.653E+01)		(2.509E+00, 1.769E+02)		(7.286E+00, -8.682E+01)		
9	(4.012E-01, 4.584E+01)		(9.301E-01, 1.650E+02)		(7.083E+00, 5.657E+01)		
10	(4.012E-01, -4.584E+01)		(9.301E-01, -1.650E+02)		(7.083E+00, -5.657E+01)		
11	(1.124E-01, 1.718E+02)		(6.877E-03, -1.011E+02)		(1.994E-01, -8.108E+01)		
12	(1.124E-01, -1.718E+02)		(6.877E-03, 1.011E+02)		(1.994E-01, 8.108E+01)		
13	(7.238E-01, 1.800E+02)		(4.825E+00, 0.)		(1.771E+01, 1.800E+02)		
14	(0. , 0.)		(0. , 0.)		(0. , 0.)		
15	(0. , 0.)		(0. , 0.)		(0. , 0.)		

THE D-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(-6.990E-05, -3.520E-05)	(-7.559E-06, 1.537E-05)	(-3.040E-04, -2.355E-04)	(2.621E-05, -2.005E-05)
2	(-6.990E-05, 3.520E-05)	(-7.559E-06, -1.537E-05)	(-3.040E-04, 2.355E-04)	(2.621E-05, 2.005E-05)
3	(-4.196E-10, 4.056E-10)	(-1.578E-10, -6.500E-10)	(1.434E-08, -3.342E-09)	(-7.155E-10, -1.860E-09)
4	(-4.196E-10, -4.056E-10)	(-1.578E-10, 6.500E-10)	(1.434E-08, 3.342E-09)	(-7.155E-10, 1.860E-09)
5	(-1.093E-04, 9.566E-06)	(4.902E-06, 1.813E-05)	(-1.790E-04, 5.197E-05)	(6.510E-06, 1.822E-06)
6	(-1.093E-04, -9.566E-06)	(4.902E-06, -1.813E-05)	(-1.790E-04, -5.197E-05)	(6.510E-06, -1.822E-06)
7	(-2.891E-04, -2.899E-05)	(-2.709E-06, 5.174E-05)	(-5.231E-04, 8.827E-05)	(1.888E-05, 2.099E-06)
8	(-2.891E-04, 2.899E-05)	(-2.709E-06, -5.174E-05)	(-5.231E-04, -8.827E-05)	(1.888E-05, -2.099E-06)
9	(-8.356E-03, 4.944E-03)	(8.018E-05, 3.749E-04)	(-8.498E-04, 2.609E-04)	(1.520E-04, 3.753E-05)
10	(-8.356E-03, -4.944E-03)	(8.018E-05, -3.749E-04)	(-8.498E-04, -2.609E-04)	(1.520E-04, -3.753E-05)
11	(8.294E-03, -8.023E-04)	(-4.875E-06, -1.547E-05)	(9.296E-07, -3.462E-07)	(1.370E-07, -1.602E-05)
12	(8.294E-03, 8.023E-04)	(-4.875E-06, 1.547E-05)	(9.296E-07, 3.462E-07)	(1.370E-07, 1.602E-05)
13	(0, 0)	(0, 0)	(0, 0)	(0, 0)
14	(-7.788E-02, 0)	(-2.395E-02, 0)	(2.275E-01, 0)	(-2.529E-02, 0)
15	(7.894E-02, 0)	(2.381E-02, 0)	(-2.238E-01, 0)	(2.468E-02, 0)
	5	6	7	
1	(-2.210E-04, -4.136E-05)	(1.906E-03, -4.676E-03)	(-1.024E-02, -2.291E-02)	
2	(-2.210E-04, 4.136E-05)	(1.906E-03, 4.676E-03)	(-1.024E-02, 2.291E-02)	
3	(-2.221E-07, -2.943E-07)	(6.527E-06, -4.831E-06)	(-1.193E-05, -1.488E-05)	
4	(-2.221E-07, 2.943E-07)	(6.527E-06, 4.831E-06)	(-1.193E-05, 1.488E-05)	
5	(4.317E-04, -4.142E-04)	(4.190E-03, 4.209E-03)	(1.341E-02, -1.177E-02)	
6	(4.317E-04, 4.142E-04)	(4.190E-03, -4.209E-03)	(1.341E-02, 1.177E-02)	
7	(-4.542E-04, 4.464E-04)	(-4.007E-03, 5.144E-03)	(-1.357E-02, 1.320E-02)	
8	(-4.542E-04, -4.464E-04)	(-4.007E-03, -5.144E-03)	(-1.357E-02, -1.320E-02)	
9	(9.031E-05, 4.187E-04)	(-9.499E-04, -2.899E-04)	(1.904E-04, 7.561E-03)	
10	(9.031E-05, -4.187E-04)	(-9.499E-04, 2.899E-04)	(1.904E-04, -7.561E-03)	
11	(-5.410E-06, -1.540E-05)	(9.241E-07, -3.786E-07)	(2.894E-05, -1.122E-06)	
12	(-5.410E-06, 1.540E-05)	(9.241E-07, 3.786E-07)	(2.894E-05, 1.122E-06)	
13	(0, 0)	(0, 0)	(0, 0)	
14	(-6.947E-03, 0)	(6.600E-02, 0)	(2.981E+00, 0)	
15	(7.265E-03, 0)	(-6.829E-02, 0)	(-2.909E+00, 0)	

DISTURBANCE RESIDUE MATRIX (15 BY 7)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

1	(7.827E-05, -1.533E+02)	1	(1.713E-05, 1.162E+02)	2	(3.846E-04, -1.422E+02)	3	(3.300E-05, -3.742E+01)	4	(3.300E-05, -3.742E+01)
2	(7.827E-05, 1.533E+02)	2	(1.713E-05, -1.162E+02)	3	(3.846E-04, 1.422E+02)	4	(3.300E-05, 3.742E+01)		
3	(5.838E-10, 1.360E+02)	3	(6.689E-10, -1.036E+02)	4	(1.473E-08, -1.312E+01)		(1.993E-09, -1.110E+02)		
4	(5.838E-10, -1.360E+02)	4	(6.689E-10, 1.036E+02)	5	(1.473E-08, 1.312E+01)		(1.993E-09, 1.110E+02)		
5	(1.097E-04, 1.750E+02)	5	(1.878E-05, 7.487E+01)	6	(1.864E-04, 1.638E+02)		(6.760E-06, -1.564E+01)		
6	(1.097E-04, -1.750E+02)	6	(1.878E-05, -7.487E+01)	7	(5.182E-05, 9.300E+01)		(6.760E-06, 1.564E+01)		
7	(2.906E-04, -1.743E+02)	7	(5.182E-05, 9.300E+01)	8	(5.182E-05, -9.300E+01)		(1.899E-05, 6.345E+00)		
8	(2.906E-04, 1.743E+02)	8	(5.182E-05, -9.300E+01)	9	(3.834E-04, 7.793E+01)		(1.899E-05, -6.345E+00)		
9	(9.711E-03, 1.494E+02)	9	(3.834E-04, 7.793E+01)	10	(9.711E-03, -1.494E+02)		(1.566E-04, 1.387E+01)		
10	(8.333E-03, -5.525E+00)	10	(3.834E-04, -7.793E+01)	11	(1.622E-05, -1.075E+02)		(1.566E-04, -1.387E+01)		
11	(8.333E-03, 5.525E+00)	11	(1.622E-05, 1.075E+02)	12	(1.622E-05, -1.075E+02)		(1.602E-05, -8.951E+01)		
12	(0. , 0.)	12	(0. , 0.)	13	(0. , 0.)		(1.602E-05, 8.951E+01)		
13	(7.788E-02, 1.800E+02)	13	(2.395E-02, 1.800E+02)	14	(2.395E-02, -1.800E+02)		(0. , 0.)		
14	(7.788E-02, -1.800E+02)	14	(2.395E-02, -1.800E+02)	15	(7.894E-02, 0.)		(2.529E-02, 1.800E+02)		
15	(7.894E-02, 0.)	15	(2.381E-02, 0.)				(2.488E-02, 0.)		
1	(2.248E-04, -1.694E+02)	5	(5.049E-03, -6.783E+01)	6	(5.049E-03, 6.783E+01)	7	(2.510E-02, -1.141E+02)		
2	(2.248E-04, 1.694E+02)	6	(5.049E-03, 6.783E+01)	7	(5.049E-03, -6.783E+01)		(2.510E-02, 1.141E+02)		
3	(3.687E-07, -1.270E+02)	7	(8.120E-06, -3.651E+01)	8	(8.120E-06, 3.651E+01)		(1.907E-05, -1.287E+02)		
4	(3.687E-07, 1.270E+02)	8	(8.120E-06, 3.651E+01)	9	(5.939E-03, 4.514E+01)		(1.907E-05, 1.287E+02)		
5	(5.983E-04, -4.381E+01)	9	(5.939E-03, 4.514E+01)	10	(5.939E-03, -4.514E+01)		(1.784E-02, -4.126E+01)		
6	(5.983E-04, 4.381E+01)	10	(5.939E-03, -4.514E+01)	11	(5.939E-03, 4.514E+01)		(1.784E-02, 4.126E+01)		
7	(6.365E-04, 1.355E+02)	11	(5.939E-03, 4.514E+01)	12	(6.521E-03, -1.279E+02)		(1.893E-02, 1.358E+02)		
8	(6.365E-04, -1.355E+02)	12	(6.521E-03, -1.279E+02)	13	(6.521E-03, 1.279E+02)		(1.893E-02, -1.358E+02)		
9	(4.284E-04, 7.783E+01)	13	(6.521E-03, 1.279E+02)	14	(9.931E-04, -1.530E+02)		(7.563E-03, 8.856E+01)		
10	(4.284E-04, -7.783E+01)	14	(9.931E-04, -1.530E+02)	15	(9.931E-04, 1.530E+02)		(7.563E-03, -8.856E+01)		
11	(1.633E-05, -1.094E+02)	15	(9.931E-04, 1.530E+02)				(2.896E-05, -2.219E+00)		
12	(1.633E-05, 1.094E+02)						(2.896E-05, 2.219E+00)		
13	(0. , 0.)						(0. , 0.)		
14	(6.947E-03, 1.800E+02)						(2.981E+00, 0.)		
15	(7.265E-03, 0.)						(2.909E+00, 1.800E+02)		

CONFIGURATION 3

MATRIX (12 BY 12)											
THE AC		1	2	3	4	5	6				
1	-1.208E+00	9.440E-01	-6.340E-04	0.	-8.940E-03	9.525E-02					
2	-7.059E+00	-2.018E+00	-2.290E-03	0.	-1.842E-01	-1.248E-01					
3	-2.500E+01	0.	-2.500E-02	-3.220E+01	0.	0.					
4	0.	1.000E+00	0.	0.	0.	0.					
5	0.	0.	0.	0.	0.	0.					
6	0.	0.	0.	0.	0.	0.					
7	0.	0.	0.	0.	0.	0.					
8	0.	0.	0.	0.	0.	0.					
9	-7.383E+02	-1.333E+02	-1.435E-03	0.	-1.068E+02	-1.568E+01					
10	1.300E+03	1.633E+01	0.	0.	1.407E+01	-5.061E+02					
11	7.577E+02	5.595E+01	-3.900E-03	0.	6.990E+00	3.458E+01					
12	1.688E+00	3.990E-02	0.	0.	1.623E-02	-9.700E-02					

MATRIX (2 BY 2)											
THE AC		1	2								
1	-9.400E+00	0.									
2	-2.256E-02	-9.500E+00									

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THE D MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	-7.371E+02
10	0.	1.298E+03
11	0.	7.564E+02
12	0.	1.697E+00

THE E VECTOR (7 BY 1)

1
1
2
3
4
5
6
7

THE F MATRIX (7 BY 2)

	1	2
1	0.	0.
2	0.	0.
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	9.243E+00

THE GG VECTOR (15 BY 1)

1
1 0.
2 1.000E+00
3 5.621E-03
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

AP = -6.667E+00

THE GP VECTOR (15 BY 1)

1
1 1.000E+00
2 0.
3 0.
4 0.
5 0.
6 0.
7 0.
8 0.
9 0.
10 0.
11 0.
12 0.
13 0.
14 0.
15 0.

THE A0-SCALED MATRIX (12 BY 12)

	1	2	3	4	5	6
1	-1.208E+00	9.440E-01	-6.017E-01	0.	3.386E-01	-2.886E+00
2	-7.059E+00	-2.018E+00	-2.173E+00	0.	6.977E+00	3.782E+00
3	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.	0.
4	0.	1.000E+00	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	1.949E+01	3.519E+00	3.595E-02	0.	-1.068E+02	-1.254E+01
10	-4.290E+01	-5.389E-01	0.	0.	1.759E+01	-5.061E+02
11	-2.619E+01	-1.934E+00	1.219E-01	0.	9.151E+00	3.621E+01
12	-6.138E-02	-1.451E-03	0.	0.	2.235E-02	-1.069E-01

	7	8	9	10	11	12
1	-1.336E-01	1.195E-01	8.068E-03	-7.848E-02	-4.416E-03	1.375E-04
2	-5.995E+00	2.522E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	1.000E+00	0.	0.	0.
6	0.	0.	0.	1.000E+00	0.	0.
7	0.	0.	0.	0.	1.000E+00	0.
8	0.	0.	0.	0.	0.	1.000E+00
9	-1.176E+01	1.516E+01	-1.023E+00	-2.216E-01	6.996E-01	-1.435E-01
10	6.295E+00	1.020E+01	2.939E-01	-8.596E+00	1.080E-01	1.017E-01
11	-9.385E+01	3.286E+00	-1.596E-01	3.963E+00	-3.721E-01	-2.410E-01
12	7.482E-03	-4.849E+02	-4.531E-04	2.674E-03	-2.908E-04	-4.080E-01

THE B-SCALED VECTOR (12 BY 1)

	1
1	-2.884E-01
2	-1.503E+01
3	0.
4	0.
5	0.
6	0.
7	0.
8	0.
9	5.886E+01
10	7.103E+00
11	-2.120E+01
12	-3.921E-03

 THE C-SCALED MATRIX (7 BY 12)

	1	2	3	4	5	6
1	0.	0.	5.490E+02	0.	0.	0.
2	0.	0.	0.	1.000E+00	0.	0.
3	0.	1.000E+00	0.	0.	0.	0.
4	-1.000E+00	0.	0.	1.000E+00	0.	0.
5	0.	0.	0.	1.000E+00	-1.000E+00	-1.000E+00
6	0.	1.000E+00	0.	0.	0.	0.
7	5.322E+00	-1.395E+00	1.350E+01	0.	-3.200E+01	-9.740E+01

	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	-1.000E+00	-1.000E+00	0.	0.	0.	0.
6	0.	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-2.553E+01	-4.599E+01	-1.814E-02	-3.342E+00	1.111E-03	-3.954E-03

 THE D-SCALED MATRIX (12 BY 2)

	1	2
1	0.	-1.204E+00
2	0.	-7.049E+00
3	0.	0.
4	0.	0.
5	0.	0.
6	0.	0.
7	0.	0.
8	0.	0.
9	0.	1.946E+01
10	0.	-4.283E+01
11	0.	-2.614E+01
12	0.	-6.170E-02

THE AA MATRIX (15 BY 15)

	1	2	3	4	5	6	7	8
1	-6.667E+00	0.	0.	0.	0.	0.	0.	0.
2	0.	-9.400E+00	0.	0.	0.	0.	0.	0.
3	0.	-2.256E-02	-9.500E+00	0.	0.	0.	0.	0.
4	-2.884E-01	0.	-1.208E+00	9.440E-01	-6.017E-01	0.	0.	3.386E-01
5	-1.503E+01	0.	-7.059E+00	-2.018E+00	-2.173E+00	0.	0.	6.977E+00
6	0.	0.	-2.634E-02	0.	-2.500E-02	-3.393E-02	0.	0.
7	0.	0.	0.	1.000E+00	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.
12	5.886E+01	0.	1.946E+01	1.949E+01	3.519E+00	3.595E-02	0.	-1.068E+02
13	7.103E+00	0.	-4.283E+01	-4.290E+01	-5.389E-01	0.	0.	1.759E+01
14	-2.120E+01	0.	-2.614E+01	-2.619E+01	-1.934E+00	1.27E-01	0.	9.151E+00
15	-3.921E-03	0.	-6.170E-02	-6.138E-02	-1.451E-03	0.	0.	2.235E-02

	9	10	11	12	13	14	15
1	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.
4	-2.886E+00	-1.336E-01	1.195E-01	8.068E-03	-7.848E-02	-4.416E-03	1.375E-04
5	3.782E+00	-5.995E+00	2.522E+00	2.817E-01	-1.507E+00	-2.015E-01	5.512E-02
6	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	1.000E+00	0.	0.	0.
8	0.	0.	0.	0.	1.000E+00	0.	0.
9	0.	0.	0.	0.	0.	1.000E+00	0.
10	0.	0.	0.	0.	0.	0.	1.000E+00
11	0.	0.	0.	0.	0.	0.	0.
12	-1.254E+01	-1.176E+01	1.516E+01	-1.023E+00	-2.216E-01	6.996E-01	-1.435E-01
13	-5.061E+02	6.295E+00	1.020E+01	2.939E-01	-8.556E+00	1.080E-01	1.017E-01
14	3.621E+01	-9.385E+01	3.286E+00	-1.596E-01	3.963E+00	-3.721E-01	-2.410E-01
15	-1.069E-01	7.482E-03	-4.849E+02	-4.531E-04	2.674E-03	-2.908E-04	-4.080E-01

THE CC MATRIX (7 BY 15)

	1	2	3	4	5
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	1.000E+00
3	0.	0.	0.	-1.300E+00	0.
4	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	1.000E+00
6	0.	0.	9.243E+00	9.322E+00	-1.395E+00
7	2.327E+00	0.	0.	0.	0.
	6	7	8	9	10
1	9.490E+02	0.	0.	0.	0.
2	0.	1.000E+00	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	1.000E+00	0.	0.	0.
5	0.	1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
6	0.	0.	0.	0.	0.
7	1.350E+01	0.	-3.200E+01	-9.740E+01	-2.553E+01
	11	12	13	14	15
1	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.
5	-1.000E+00	0.	0.	0.	0.
6	0.	-1.000E+00	-1.000E+00	-1.000E+00	-1.000E+00
7	-4.599E+01	-1.814E+02	-3.342E+00	1.111E-03	-3.964E-03

SPECTRAL DECOMPOSITION OF A-AUG

	REAL PART	IMAGINARY PART	FREQUENCY (HERTZ)	DAMPING RATIO	TIME CONST. (SEC/RAD)
1	-4.50537E+00	2.13997E+01	3.57402E+00	.20062865	2.21957E-01
3	-2.03840E-01	2.20495E+01	3.50466E+00	.00925686	4.90581E+00
5	-1.13765E+00	1.03012E+01	1.64946E+00	.10977040	8.79009E-01
7	1.49564E-01	9.78322E+00	1.55723E+00	-.01528603	-6.68610E+00
9	-1.13078E+00	2.01535E+00	3.67792E-01	.48932412	8.84343E-01
11	3.222E-03	6.00201E-02	9.56626E-03	-.05361388	-3.10314E+02
13	-6.666E-03	0.	0.	1.00000000	1.50000E-01
14	-9.50000E+00	0.	0.	1.00000000	1.05263E-01
15	-9.40000E+00	0.	0.	1.00000000	1.063E-01

14	(2.476E-01, -3.823E-02)	(2.476E-01, 3.823E-02)	(-4.161E-03, -2.010E-03)	(-4.161E-03, 2.010E-03)
15	(8.380E-05, -2.499E-05)	(8.380E-05, 2.499E-05)	(-1.488E-06, -7.145E-07)	(-1.488E-06, 7.145E-07)
13				
1	(2.667E-01, 0.	(0.	(0.682E-01, 0.	
2	(0.	(0.	(-1.959E-01, 0.	
3	(0.	(3.949E-01, 0.	(-9.297E-04, 0.	
4	(-8.145E-02, 0.	(2.286E-03, 0.	(-1.944E-01, 0.	
5	(5.493E-01, 0.	(3.888E-01, 0.	(7.223E-05, 0.	
6	(-7.440E-04, 0.	(-1.402E-04, 0.	(2.068E-02, 0.	
7	(-8.240E-02, 0.	(-4.092E-02, 0.	(-2.812E-02, 0.	
8	(1.128E-01, 0.	(5.609E-02, 0.	(1.610E-02, 0.	
9	(1.362E-02, 0.	(-3.245E-02, 0.	(2.912E-02, 0.	
10	(-2.425E-02, 0.	(-5.810E-02, 0.	(1.730E-05, 0.	
11	(7.768E-06, 0.	(-3.480E-05, 0.	(2.643E-01, 0.	
12	(-7.521E-01, 0.	(-5.328E-01, 0.	(-1.514E-01, 0.	
13	(-9.083E-02, 0.	(3.083E-01, 0.	(-2.738E-01, 0.	
14	(1.619E-01, 0.	(5.520E-01, 0.	(-1.626E-04, 0.	
15	(-5.179E-05, 0.	(3.306E-04, 0.		
14				
	(0.	(0.	(0.682E-01, 0.	
	(0.	(3.949E-01, 0.	(-1.959E-01, 0.	
	(2.286E-03, 0.	(-9.297E-04, 0.	(-1.944E-01, 0.	
	(3.888E-01, 0.	(7.223E-05, 0.	(2.068E-02, 0.	
	(-1.402E-04, 0.	(-2.812E-02, 0.	(1.610E-02, 0.	
	(-4.092E-02, 0.	(2.912E-02, 0.	(1.730E-05, 0.	
	(5.609E-02, 0.	(2.643E-01, 0.	(-1.514E-01, 0.	
	(-3.245E-02, 0.	(-2.738E-01, 0.	(-1.626E-04, 0.	
	(-5.810E-02, 0.			
	(-3.480E-05, 0.			
	(-5.328E-01, 0.			
	(3.083E-01, 0.			
	(5.520E-01, 0.			
	(3.306E-04, 0.			

ORIGINAL PAGE IS
OF POOR QUALITY

THE CON VECTOR (15 BY 1)

```

1 ( 4.700E-03, 8.243E-02 )
2 ( 4.700E-03, -8.243E-02 )
3 ( 1.396E-04, -2.956E-05 )
4 ( 1.396E-04, 2.956E-05 )
5 ( -9.947E-01, 2.155E+00 )
6 ( -9.947E-01, -2.155E+00 )
7 ( -9.593E-01, 7.571E-02 )
8 ( -9.593E-01, -7.571E-02 )
9 ( 9.661E-01, 4.999E-01 )
10 ( 9.661E-01, -4.999E-01 )
11 ( -1.252E-01, 5.561E-02 )
12 ( -1.252E-01, -5.561E-02 )
13 ( 3.750E+00, 0. )
14 ( 0. , 0. )
15 ( 0. , 0. )

```

CONTROLABILITY MATRIX (15 BY 1)
OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1
2 ( 9.97E-02, 9.674E+01 )
3 ( 9.97E-02, -9.674E+01 )
4 ( 1.42E-04, -1.196E+01 )
5 ( 1.42E-04, 1.196E+01 )
6 ( 2.373E+00, 1.148E+02 )
7 ( 2.373E+00, -1.148E+02 )
8 ( 9.623E-01, 1.755E+02 )
9 ( 9.623E-01, -1.755E+02 )
10 ( 1.088E+00, 2.736E+01 )
11 ( 1.088E+00, -2.736E+01 )
12 ( 1.370E-01, 1.561E+02 )
13 ( 1.370E-01, -1.561E+02 )
14 ( 3.750E+00, 0. )
15 ( 0. , 0. )

```

THE DIST VECTOR (15 BY 1)

```

1 ( 2.836E-03, -4.869E-03 )
2 ( 2.836E-03, 4.869E-03 )
3 ( 7.680E-06, 3.621E-06 )
4 ( 7.680E-06, -3.621E-06 )
5 ( -5.448E-03, 3.220E-04 )
6 ( -5.448E-03, -3.220E-04 )
7 ( -2.350E-03, 2.947E-03 )
8 ( -2.350E-03, -2.947E-03 )
9 ( 5.817E-04, 9.622E-04 )
10 ( 5.817E-04, -9.622E-04 )
11 ( -1.093E-05, -1.552E-05 )
12 ( -1.093E-05, 1.552E-05 )
13 ( 0, 0 )
14 ( 5.855E-01, 0 )
15 ( 1.152E+00, 0 )

```

DISTURBABILITY MATRIX (15 BY 1)
OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1 ( 5.635E-03, -5.978E+01 )
2 ( 5.635E-03, 5.978E+01 )
3 ( 8.491E-06, 2.525E+01 )
4 ( 8.491E-06, -2.525E+01 )
5 ( 5.457E-03, 1.766E+02 )
6 ( 5.457E-03, -1.766E+02 )
7 ( 3.769E-03, 1.286E+02 )
8 ( 3.769E-03, -1.286E+02 )
9 ( 1.124E-03, 5.884E+01 )
10 ( 1.124E-03, -5.884E+01 )
11 ( 1.898E-05, -1.251E+02 )
12 ( 1.898E-05, 1.251E+02 )
13 ( 0, 0 )
14 ( 5.855E-01, 0 )
15 ( 1.152E+00, 0 )

```

THE OBS MATRIX (7 BY 15)

```

1 ( -8.549E-04, -1.388E-02 ) ( -8.549E-04, 1.388E-02 ) ( -2.641E-05, 6.484E-05 ) ( -2.641E-05, -6.484E-05 )
2 ( -3.037E-03, 2.160E-04 ) ( -3.037E-03, -2.160E-04 ) ( -4.901E-05, -6.052E-05 ) ( -4.901E-05, 6.052E-05 )
3 ( 8.929E-03, -6.778E-02 ) ( 8.929E-03, 6.778E-02 ) ( 1.343E-03, -1.067E-03 ) ( 1.343E-03, 1.067E-03 )
4 ( 5.421E-03, 2.230E-03 ) ( 5.421E-03, -2.230E-03 ) ( -1.691E-04, -1.622E-04 ) ( -1.691E-04, 1.622E-04 )
5 ( -1.340E-02, -3.783E-02 ) ( -1.340E-02, 3.783E-02 ) ( -3.846E-02, -2.018E-02 ) ( -3.846E-02, 2.018E-02 )
6 ( 8.926E-01, -1.243E-01 ) ( 8.926E-01, 1.243E-01 ) ( 4.522E-01, -8.428E-01 ) ( 4.522E-01, 8.428E-01 )
7 ( 2.608E+00, -3.641E+00 ) ( 2.608E+00, 3.641E+00 ) ( -2.015E+00, -9.828E-01 ) ( -2.015E+00, 9.828E-01 )

1 ( 4.567E-02, 1.339E-02 ) ( 4.567E-02, -1.339E-02 ) ( 3.142E-02, 2.707E-02 ) ( 3.142E-02, -2.707E-02 )
2 ( 1.980E-03, -8.359E-03 ) ( 1.980E-03, 8.359E-03 ) ( 3.603E-03, -6.012E-03 ) ( 3.603E-03, 6.012E-03 )
3 ( 8.385E-02, 2.990E-02 ) ( 8.385E-02, -2.990E-02 ) ( 5.936E-02, 3.435E-02 ) ( 5.936E-02, -3.435E-02 )
4 ( -3.019E-03, -9.031E-04 ) ( -3.019E-03, 9.031E-04 ) ( -2.131E-03, -1.272E-03 ) ( -2.131E-03, 1.272E-03 )
5 ( 4.275E-02, -5.380E-02 ) ( 4.275E-02, 5.380E-02 ) ( -1.022E-01, -1.473E-02 ) ( -1.022E-01, 1.473E-02 )
6 ( 5.055E-01, 5.016E-01 ) ( 5.055E-01, -5.016E-01 ) ( -1.594E-01, -9.975E-01 ) ( -1.594E-01, 9.975E-01 )
7 ( 1.303E+00, -2.004E+00 ) ( 1.303E+00, 2.004E+00 ) ( -3.183E+00, 2.645E-02 ) ( -3.183E+00, -2.645E-02 )

1 ( -3.462E-02, 8.638E+00 ) ( -3.462E-02, -8.638E+00 ) ( -2.156E+02, 3.815E+02 ) ( -2.156E+02, -3.815E+02 )
2 ( 3.215E-01, 1.100E-01 ) ( 3.215E-01, -1.100E-01 ) ( 8.004E-01, 2.496E-01 ) ( 8.004E-01, -2.496E-01 )
3 ( -5.852E-01, 5.235E-01 ) ( -5.852E-01, -5.235E-01 ) ( -1.240E-02, -4.885E-02 ) ( -1.240E-02, 4.885E-02 )
4 ( 4.076E-02, -1.332E-01 ) ( 4.076E-02, 1.332E-01 ) ( 6.722E-01, 4.842E-01 ) ( 6.722E-01, -4.842E-01 )
5 ( 3.686E-01, 1.378E-01 ) ( 3.686E-01, -1.378E-01 ) ( 8.197E-01, 2.141E-01 ) ( 8.197E-01, -2.141E-01 )
6 ( -6.946E-01, 5.871E-01 ) ( -6.946E-01, -5.871E-01 ) ( -1.021E-02, 4.589E-02 ) ( -1.021E-02, -4.589E-02 )
7 ( 5.838E+00, 3.355E+00 ) ( 5.838E+00, -3.355E+00 ) ( -7.993E-01, 1.235E+00 ) ( -7.993E-01, -1.235E+00 )

1 ( -7.061E-01, 0. ) ( -1.330E-01, 0. ) ( 6.855E-02, 0. ) ( 6.855E-02, 0. )
2 ( -8.240E-02, 0. ) ( -4.092E-02, 0. ) ( 2.068E-02, 0. ) ( 2.068E-02, 0. )
3 ( 5.493E-01, 0. ) ( 3.886E-01, 0. ) ( -1.944E-01, 0. ) ( -1.944E-01, 0. )
4 ( -3.552E-04, 0. ) ( -4.321E-02, 0. ) ( 2.161E-02, 0. ) ( 2.161E-02, 0. )
5 ( -1.846E-01, 0. ) ( -6.423E-03, 0. ) ( 3.552E-03, 0. ) ( 3.552E-03, 0. )
6 ( 1.230E+00, 0. ) ( 6.102E-02, 0. ) ( -3.339E-02, 0. ) ( -3.339E-02, 0. )
7 ( -4.916E+00, 0. ) ( 4.952E+00, 0. ) ( -2.459E+00, 0. ) ( -2.459E+00, 0. )

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OBSERVABILITY MATRIX (7 BY 15)
OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

```

1 ( 1.391E-02, -9.352E+01 ) ( 1.391E-02, 9.352E+01 ) ( 7.002E-05, 1.122E+02 ) ( 7.002E-05, -1.122E+02 )
2 ( 3.044E-03, 1.759E+02 ) ( 3.044E-03, -1.759E+02 ) ( 7.788E-05, -1.290E+02 ) ( 7.788E-05, 1.290E+02 )
3 ( 6.836E-02, -8.249E+01 ) ( 6.836E-02, 8.249E+01 ) ( 1.715E-03, -3.847E+01 ) ( 1.715E-03, 3.847E+01 )
4 ( 5.862E-03, 2.236E+01 ) ( 5.862E-03, -2.236E+01 ) ( 2.343E-04, -1.362E+02 ) ( 2.343E-04, 1.362E+02 )
5 ( 4.013E-02, -1.095E+02 ) ( 4.013E-02, 1.095E+02 ) ( 4.343E-02, -1.523E+02 ) ( 4.343E-02, 1.523E+02 )
6 ( 9.012E-01, -7.925E+00 ) ( 9.012E-01, 7.925E+00 ) ( 9.564E-01, -6.179E+01 ) ( 9.564E-01, 6.179E+01 )
7 ( 4.479E+00, -5.438E+01 ) ( 4.479E+00, 5.438E+01 ) ( 2.241E+00, -1.540E+02 ) ( 2.241E+00, 1.540E+02 )

1 ( 4.759E-02, 1.634E+01 ) ( 4.759E-02, -1.634E+01 ) ( 4.147E-02, 4.075E+01 ) ( 4.147E-02, -4.075E+01 )
2 ( 8.590E-03, -7.668E+01 ) ( 8.590E-03, 7.668E+01 ) ( 7.009E-03, -5.907E+01 ) ( 7.009E-03, 5.907E+01 )
3 ( 8.903E-02, 1.963E+01 ) ( 8.903E-02, -1.963E+01 ) ( 6.858E-02, 3.006E+01 ) ( 6.858E-02, -3.006E+01 )
4 ( 3.151E-03, -1.633E+02 ) ( 3.151E-03, 1.633E+02 ) ( 2.482E-03, -1.492E+02 ) ( 2.482E-03, 1.492E+02 )
5 ( 6.872E-02, -5.153E+01 ) ( 6.872E-02, 5.153E+01 ) ( 1.032E-01, -1.718E+02 ) ( 1.032E-01, 1.718E+02 )
6 ( 7.122E-01, 4.478E+01 ) ( 7.122E-01, -4.478E+01 ) ( 1.010E+00, -9.908E+01 ) ( 1.010E+00, 9.908E+01 )
7 ( 2.390E+00, -5.696E+01 ) ( 2.390E+00, 5.696E+01 ) ( 3.184E+00, -1.795E+02 ) ( 3.184E+00, 1.795E+02 )

1 ( 8.638E+00, 9.023E+01 ) ( 8.638E+00, -9.023E+01 ) ( 4.382E+02, 1.195E+02 ) ( 4.382E+02, -1.195E+02 )
2 ( 3.398E-01, 1.889E+01 ) ( 3.398E-01, -1.889E+01 ) ( 8.385E-01, 1.732E+01 ) ( 8.385E-01, -1.732E+01 )
3 ( 7.852E-01, 1.382E+02 ) ( 7.852E-01, -1.382E+02 ) ( 5.040E-02, 1.042E+02 ) ( 5.040E-02, -1.042E+02 )
4 ( 1.393E-01, -7.299E+01 ) ( 1.393E-01, 7.299E+01 ) ( 8.285E-01, 3.577E+01 ) ( 8.285E-01, -3.577E+01 )
5 ( 3.395E-01, 2.050E+01 ) ( 3.395E-01, -2.050E+01 ) ( 8.472E-01, 1.464E+01 ) ( 8.472E-01, -1.464E+01 )
6 ( 9.094E-01, 1.398E+02 ) ( 9.094E-01, -1.398E+02 ) ( 5.092E-02, 1.016E+02 ) ( 5.092E-02, -1.016E+02 )
7 ( 6.734E+00, 2.989E+01 ) ( 6.734E+00, -2.989E+01 ) ( 1.471E+00, 1.229E+02 ) ( 1.471E+00, -1.229E+02 )

1 ( 7.061E-01, 1.800E+02 ) ( 1.330E-01, 1.800E+02 ) ( 6.855E-02, 0. ) ( 6.855E-02, 0. )
2 ( 8.240E-02, 1.800E+02 ) ( 4.092E-02, 1.800E+02 ) ( 2.068E-02, 0. ) ( 2.068E-02, 0. )
3 ( 5.493E-01, 0. ) ( 3.888E-01, 0. ) ( 1.944E-01, 1.800E+02 ) ( 1.944E-01, 1.800E+02 )
4 ( 9.552E-04, 1.800E+02 ) ( 4.321E-02, 1.800E+02 ) ( 2.161E-02, 0. ) ( 2.161E-02, 0. )
5 ( 1.842E-01, 1.800E+02 ) ( 6.423E-03, 1.800E+02 ) ( 3.552E-03, 0. ) ( 3.552E-03, 0. )
6 ( 1.230E+00, 0. ) ( 6.102E-02, 0. ) ( 3.339E-02, 1.800E+02 ) ( 3.339E-02, 1.800E+02 )
7 ( 4.915E+00, 1.800E+02 ) ( 4.958E+00, 0. ) ( 2.459E+00, 1.800E+02 ) ( 2.459E+00, 1.800E+02 )

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*****
**      RESIDUE MATRICES      **
*****
*** ROWS CORRESPOND TO MODES ***
*** COLUMNS CORRESPOND TO OUTPUTS ***
*****

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----- IMPULSE RESIDUE MATRIX FOR CONTROL - 1 -----

THE C-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(1.140E-03, -1.357E-04)	(-3.208E-05, -2.493E-04)	(5.629E-03, 4.175E-04)	(-1.583E-04, 4.573E-04)
2	(1.140E-03, 1.357E-04)	(-3.208E-05, 2.493E-04)	(5.629E-03, -4.175E-04)	(-1.583E-04, -4.573E-04)
3	(-1.770E-09, 9.831E-09)	(-8.629E-09, -6.999E-09)	(1.559E-07, -1.886E-07)	(-2.839E-08, -1.764E-08)
4	(-1.770E-09, -9.831E-09)	(-8.629E-09, 6.999E-09)	(1.559E-07, 1.886E-07)	(-2.839E-08, 1.764E-08)
5	(-7.427E-02, 8.510E-02)	(1.604E-02, 1.258E-02)	(-1.478E-01, 1.510E-01)	(4.949E-03, -5.607E-03)
6	(-7.427E-02, -8.510E-02)	(1.604E-02, -1.258E-02)	(-1.478E-01, -1.510E-01)	(4.949E-03, 5.607E-03)
7	(-3.219E-02, -2.359E-02)	(-3.001E-03, 6.041E-03)	(-5.955E-02, -2.846E-02)	(2.140E-03, 1.059E-03)
8	(-4.351E+00, 8.327E+00)	(-2.556E-01, -2.670E-01)	(-5.955E-02, 2.846E-02)	(2.140E-03, -1.059E-03)
9	(-4.351E+00, -8.327E+00)	(2.556E-01, 2.670E-01)	(-8.270E-01, 2.132E-01)	(1.060E-01, -1.083E-01)
10	(-4.351E+00, 8.327E+00)	(2.556E-01, -2.670E-01)	(-8.270E-01, -2.132E-01)	(1.060E-01, 1.083E-01)
11	(5.781E+00, -5.976E+01)	(-1.141E-01, 1.326E-02)	(-1.163E-03, -6.806E-03)	(-1.111E-01, -2.325E-02)
12	(5.781E+00, 5.976E+01)	(-1.141E-01, -1.326E-02)	(-1.163E-03, 6.806E-03)	(-1.111E-01, 2.325E-02)
13	(-2.648E+00, 0.)	(-3.090E-01, 0.)	(2.060E+00, 0.)	(-3.582E-03, 0.)
14	(0. , 0.)	(0. , 0.)	(0. , 0.)	(0. , 0.)
15	(0. , 0.)	(0. , 0.)	(0. , 0.)	(0. , 0.)

	5	6	7
1	(3.055E-03, -1.282E-03)	(1.444E-02, 7.300E-02)	(3.124E-01, 1.979E-01)
2	(3.055E-03, 1.282E-03)	(1.444E-02, -7.300E-02)	(3.124E-01, -1.979E-01)
3	(-5.965E-06, -1.680E-06)	(3.820E-05, -1.310E-04)	(-3.102E-04, -7.763E-05)
4	(-5.965E-06, 1.680E-06)	(3.820E-05, 1.310E-04)	(-3.102E-04, 7.763E-05)
5	(7.341E-02, 1.456E-01)	(-1.584E+00, 5.905E-01)	(3.022E+00, 4.801E+00)
6	(7.341E-02, -1.456E-01)	(-1.584E+00, -5.905E-01)	(3.022E+00, -4.801E+00)
7	(9.691E-02, -2.186E-02)	(2.284E-01, 9.448E-01)	(3.052E+00, -2.664E-01)
8	(9.691E-02, 2.186E-02)	(2.284E-01, -9.448E-01)	(3.052E+00, 2.664E-01)
9	(2.872E-01, 3.174E-01)	(-9.645E-01, 2.200E-01)	(3.963E+00, 6.160E+00)
10	(2.872E-01, -3.174E-01)	(-9.645E-01, -2.200E-01)	(3.963E+00, -6.160E+00)
11	(-1.146E-01, 1.876E-02)	(-1.495E-03, -6.815E-03)	(3.140E-02, -1.991E-01)
12	(-1.146E-01, -1.876E-02)	(-1.495E-03, 6.815E-03)	(3.140E-02, 1.991E-01)
13	(-6.921E-01, 0.)	(4.614E+00, 0.)	(-1.843E+01, 0.)
14	(0. , 0.)	(0. , 0.)	(0. , 0.)
15	(0. , 0.)	(0. , 0.)	(0. , 0.)

CONTROL RESIDUE MATRIX (15 BY 7)
 OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

1	(1.148E-03, -6.788E+00)	(2.514E-04, -9.733E+01)	(5.644E-03, 4.242E+00)	(4.840E-04, 1.091E+02)
2	(1.148E-03, 6.788E+00)	(2.514E-04, 9.733E+01)	(5.644E-03, -4.242E+00)	(4.840E-04, -1.091E+02)
3	(9.989E-09, 1.002E+02)	(1.111E-08, -1.410E+02)	(2.447E-07, -5.042E+01)	(3.343E-08, -1.481E+02)
4	(9.989E-09, -1.002E+02)	(1.111E-08, 1.410E+02)	(2.447E-07, 5.042E+01)	(3.343E-08, 1.481E+02)
5	(1.130E-01, 1.311E+02)	(2.039E-02, 3.810E+01)	(2.113E-01, 1.344E+02)	(7.478E-03, -4.857E+01)
6	(1.130E-01, -1.311E+02)	(2.039E-02, -3.810E+01)	(2.113E-01, -1.344E+02)	(7.478E-03, 4.857E+01)
7	(3.991E-02, -1.438E+02)	(6.745E-03, 1.164E+02)	(6.600E-02, -1.545E+02)	(2.388E-03, 2.632E+01)
8	(3.991E-02, 1.438E+02)	(6.745E-03, -1.164E+02)	(6.600E-02, 1.545E+02)	(2.388E-03, -2.632E+01)
9	(9.396E+00, 1.176E+02)	(3.696E-01, 4.625E+01)	(8.541E-01, 1.655E+02)	(1.515E-01, -4.563E+01)
10	(9.396E+00, -1.176E+02)	(3.696E-01, -4.625E+01)	(8.541E-01, -1.655E+02)	(1.515E-01, 4.563E+01)
11	(6.003E-01, -8.447E+01)	(1.149E-01, 1.734E+02)	(6.905E-03, -9.970E+01)	(1.135E-01, -1.682E+02)
12	(6.003E-01, 8.447E+01)	(1.149E-01, -1.734E+02)	(6.905E-03, 9.970E+01)	(1.135E-01, 1.682E+02)
13	(2.648E+00, 1.800E+02)	(3.090E-01, 1.800E+02)	(2.060E+00, 0.)	(3.582E-03, 1.800E+02)
14	(0. , 0.)	(0. , 0.)	(0. , 0.)	(0. , 0.)
15	(0. , 0.)	(0. , 0.)	(0. , 0.)	(0. , 0.)

1	(3.314E-03, -2.276E+01)	(7.441E-02, 7.881E+01)	(3.698E-01, 3.236E+01)	
2	(3.314E-03, 2.276E+01)	(7.441E-02, -7.881E+01)	(3.698E-01, -3.236E+01)	
3	(6.197E-06, -1.643E+02)	(1.365E-04, -7.374E+01)	(3.198E-04, -1.660E+02)	
4	(6.197E-06, 1.643E+02)	(1.365E-04, 7.374E+01)	(3.198E-04, 1.660E+02)	
5	(1.631E-01, 6.325E+01)	(1.690E+00, 1.596E+02)	(5.673E+00, 5.781E+01)	
6	(1.631E-01, -6.325E+01)	(1.690E+00, -1.596E+02)	(5.673E+00, -5.781E+01)	
7	(5.934E-02, -1.271E+01)	(9.720E-01, 7.641E+01)	(3.064E+00, -4.989E+00)	
8	(5.934E-02, 1.271E+01)	(9.720E-01, -7.641E+01)	(3.064E+00, 4.989E+00)	
9	(4.281E-01, 4.786E+01)	(9.892E-01, 1.672E+02)	(7.325E+00, 5.725E+01)	
10	(4.281E-01, -4.786E+01)	(9.892E-01, -1.672E+02)	(7.325E+00, -5.725E+01)	
11	(1.161E-01, 1.707E+02)	(6.977E-03, -1.024E+02)	(2.016E-01, -8.104E+01)	
12	(1.161E-01, -1.707E+02)	(6.977E-03, 1.024E+02)	(2.016E-01, 8.104E+01)	
13	(6.921E-01, 1.800E+02)	(4.614E+00, 0.)	(1.843E+01, 1.800E+02)	
14	(0. , 0.)	(0. , 0.)	(0. , 0.)	
15	(0. , 0.)	(0. , 0.)	(0. , 0.)	

THE D-IMP RES MATRIX (15 BY 7)

	1	2	3	4
1	(-7.001E-05, -3.521E-05)	(-7.561E-06, 1.540E-05)	(-3.047E-04, -2.357E-04)	(2.623E-05, -2.007E-05)
2	(-7.001E-05, 3.521E-05)	(-7.561E-06, -1.540E-05)	(-3.047E-04, 2.357E-04)	(2.623E-05, 2.007E-05)
3	(-4.377E-10, 4.023E-10)	(-1.572E-10, -6.423E-10)	(1.417E-08, -3.330E-09)	(-7.108E-10, -1.858E-09)
4	(-4.377E-10, -4.023E-10)	(-1.572E-10, 6.423E-10)	(1.417E-08, 3.330E-09)	(-7.108E-10, 1.858E-09)
5	(-2.531E-04, -5.822E-05)	(-8.094E-06, 4.618E-05)	(-4.665E-04, -1.359E-04)	(1.674E-05, 3.948E-06)
6	(-2.531E-04, 5.822E-05)	(-8.094E-06, -4.618E-05)	(-4.665E-04, 1.359E-04)	(1.674E-05, -3.948E-06)
7	(-1.536E-04, 2.899E-05)	(9.255E-06, 2.475E-05)	(-2.407E-04, 9.425E-05)	(8.757E-06, -3.291E-06)
8	(-1.536E-04, -2.899E-05)	(9.255E-06, -2.475E-05)	(-2.407E-04, -9.425E-05)	(8.757E-06, 3.291E-06)
9	(-8.331E-03, 4.991E-03)	(8.118E-05, 3.733E-04)	(-8.441E-04, -2.585E-04)	(1.519E-04, -3.828E-05)
10	(-8.331E-03, -4.991E-03)	(8.118E-05, -3.733E-04)	(-8.441E-04, 2.585E-04)	(1.519E-04, 3.828E-05)
11	(8.276E-03, -8.227E-04)	(-4.873E-06, -1.515E-05)	(8.936E-07, -3.413E-07)	(1.693E-07, -1.572E-05)
12	(8.276E-03, 8.227E-04)	(-4.873E-06, 1.515E-05)	(8.936E-07, 3.413E-07)	(1.693E-07, 1.572E-05)
13	(0, 0)	(0, 0)	(0, 0)	(0, 0)
14	(-7.789E-02, 0)	(-2.396E-02, 0)	(2.276E-01, 0)	(-2.530E-02, 0)
15	(7.895E-02, 0)	(2.382E-02, 0)	(-2.239E-01, 0)	(2.489E-02, 0)

	5	6	7
1	(-2.222E-04, -4.208E-05)	(1.927E-03, -4.698E-03)	(-1.033E-02, -2.303E-02)
2	(-2.222E-04, 4.208E-05)	(1.927E-03, 4.698E-03)	(-1.033E-02, 2.303E-02)
3	(-2.223E-07, -2.942E-07)	(6.524E-06, -4.835E-06)	(-1.191E-05, -1.484E-05)
4	(-2.223E-07, 2.942E-07)	(6.524E-06, 4.835E-06)	(-1.191E-05, 1.484E-05)
5	(-2.156E-04, 3.069E-04)	(-2.916E-03, -2.570E-03)	(-6.454E-03, 1.134E-02)
6	(-2.156E-04, -3.069E-04)	(-2.916E-03, 2.570E-03)	(-6.454E-03, -1.134E-02)
7	(1.967E-04, -3.358E-04)	(3.314E-03, 1.874E-03)	(7.403E-03, -9.445E-03)
8	(1.967E-04, 3.358E-04)	(3.314E-03, -1.874E-03)	(7.403E-03, 9.445E-03)
9	(8.183E-05, 4.348E-04)	(-9.689E-04, -3.268E-04)	(1.676E-04, 7.565E-03)
10	(8.183E-05, -4.348E-04)	(-9.689E-04, 3.268E-04)	(1.676E-04, -7.565E-03)
11	(-5.635E-06, -1.506E-05)	(8.858E-07, -3.867E-07)	(2.790E-05, -1.091E-06)
12	(-5.635E-06, 1.506E-05)	(8.858E-07, 3.867E-07)	(2.790E-05, 1.091E-06)
13	(0, 0)	(0, 0)	(0, 0)
14	(-3.761E-03, 0)	(3.573E-02, 0)	(2.903E+00, 0)
15	(4.091E-03, 0)	(-3.845E-02, 0)	(-2.832E+00, 0)

DISTURBANCE RESIDUE MATRIX (15 BY 7)
OUTPUT FORM: (MAGNITUDE , PHASE(DEG.))

1	(7.836E-05, -1.533E+02)	1	(1.715E-05, 1.162E+02)	3	(3.852E-04, -1.423E+02)	4	(3.303E-05, -3.742E+01)
2	(7.836E-05, 1.533E+02)	2	(1.715E-05, -1.162E+02)		(3.852E-04, 1.423E+02)		(3.303E-05, 3.742E+01)
3	(5.945E-10, 1.374E+02)		(6.612E-10, -1.038E+02)		(1.456E-08, -1.322E+01)		(1.989E-09, -1.109E+02)
4	(5.945E-10, -1.374E+02)		(6.612E-10, 1.038E+02)		(1.456E-08, 1.322E+01)		(1.989E-09, 1.109E+02)
5	(2.597E-04, -1.670E+02)		(4.688E-05, 9.994E+01)		(4.859E-04, -1.638E+02)		(1.719E-05, 1.327E+01)
6	(2.597E-04, 1.670E+02)		(4.688E-05, -9.994E+01)		(4.859E-04, 1.638E+02)		(1.719E-05, -1.327E+01)
7	(1.563E-04, 1.693E+02)		(2.642E-05, 6.950E+01)		(2.585E-04, 1.586E+02)		(9.355E-06, -2.060E+01)
8	(1.563E-04, -1.693E+02)		(2.642E-05, -6.950E+01)		(2.585E-04, -1.586E+02)		(9.355E-06, 2.060E+01)
9	(9.712E-03, 1.491E+02)		(3.820E-04, 7.773E+01)		(8.828E-04, -1.630E+02)		(1.566E-04, -1.414E+01)
10	(9.712E-03, -1.491E+02)		(3.820E-04, -7.773E+01)		(8.828E-04, 1.630E+02)		(1.566E-04, 1.414E+01)
11	(8.317E-03, -5.677E+00)		(1.591E-05, -1.078E+02)		(9.566E-07, -2.090E+01)		(1.572E-05, -8.938E+01)
12	(8.317E-03, 5.677E+00)		(1.591E-05, 1.078E+02)		(9.566E-07, 2.090E+01)		(1.572E-05, 8.938E+01)
13	(0., 0.)		(0., 0.)		(0., 0.)		(0., 0.)
14	(7.789E-02, 1.800E+02)		(2.396E-02, 1.800E+02)		(2.276E-01, 0.)		(2.530E-02, 1.800E+02)
15	(7.895E-02, 0.)		(2.382E-02, 0.)		(2.239E-01, 1.800E+02)		(2.489E-02, 0.)
1	(2.261E-04, -1.693E+02)	5	(5.078E-03, -6.770E+01)	6	(2.524E-02, -1.142E+02)	7	(2.524E-02, -1.142E+02)
2	(2.261E-04, 1.693E+02)		(5.078E-03, 6.770E+01)		(2.524E-02, 1.142E+02)		(2.524E-02, 1.142E+02)
3	(3.688E-07, -1.271E+02)		(8.121E-06, -3.654E+01)		(1.903E-05, -1.287E+02)		(1.903E-05, -1.287E+02)
4	(3.688E-07, 1.271E+02)		(8.121E-06, 3.654E+01)		(1.903E-05, 1.287E+02)		(1.903E-05, 1.287E+02)
5	(3.750E-04, 1.251E+02)		(3.887E-03, -1.386E+02)		(1.304E-02, 1.197E+02)		(1.304E-02, 1.197E+02)
6	(3.750E-04, -1.251E+02)		(3.887E-03, 1.386E+02)		(1.304E-02, -1.197E+02)		(1.304E-02, -1.197E+02)
7	(3.892E-04, -5.964E+01)		(3.808E-03, 2.949E+01)		(1.200E-02, 5.191E+01)		(1.200E-02, 5.191E+01)
8	(3.892E-04, 5.964E+01)		(3.808E-03, -2.949E+01)		(1.200E-02, -5.191E+01)		(1.200E-02, -5.191E+01)
9	(4.425E-04, 7.934E+01)		(1.023E-03, -1.614E+02)		(7.571E-03, 8.873E+01)		(7.571E-03, 8.873E+01)
10	(4.425E-04, -7.934E+01)		(1.023E-03, 1.614E+02)		(7.571E-03, -8.873E+01)		(7.571E-03, -8.873E+01)
11	(1.608E-05, -1.105E+02)		(9.665E-07, -2.358E+01)		(2.792E-05, -2.240E+00)		(2.792E-05, -2.240E+00)
12	(1.608E-05, 1.105E+02)		(9.665E-07, 2.358E+01)		(2.792E-05, 2.240E+00)		(2.792E-05, 2.240E+00)
13	(0., 0.)		(0., 0.)		(0., 0.)		(0., 0.)
14	(3.761E-03, 1.800E+02)		(3.573E-02, 0.)		(2.903E+00, 0.)		(2.903E+00, 0.)
15	(4.091E-03, 0.)		(3.845E-02, 1.800E+02)		(2.832E+00, 1.800E+02)		(2.832E+00, 1.800E+02)

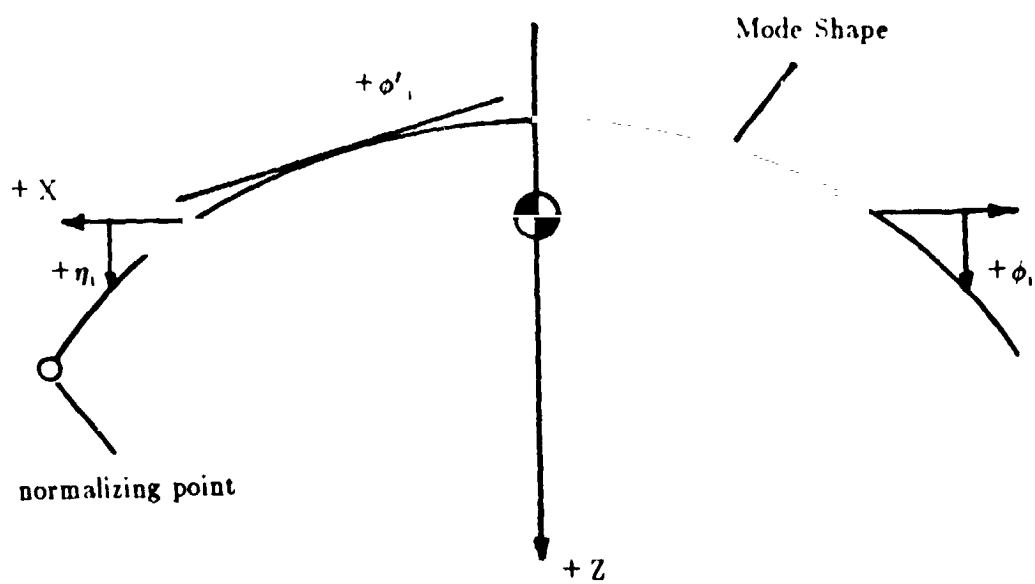
Appendix A.4

Aeroelastic-Structural Mode Shapes

The mode shapes of the data base configurations are defined to be deflections in feet normalized so that for each mode the deflection at the nose (i.e. F.S. 0) is one foot. The deflections are defined relative to a set of body axes defined in the following way. The x-axis lies along the longitudinal axis of the vehicle and is directed forward. The y-axis lies in the plane of the wings, is orthogonal to the x-axis and points out the right wing. The z-axis is orthogonal to the xy-plane and is directed downward. The origin of the xyz-coordinate system is defined to be the center of gravity of the aircraft.

The deflection definitions and their sign conventions that are used in this study are defined in Figure A.4.1. The mode shapes for the four longitudinal modes used in this study are presented in Figures A.4.2 through A.4.5.

MODE SHAPE SIGN CONVENTIONS

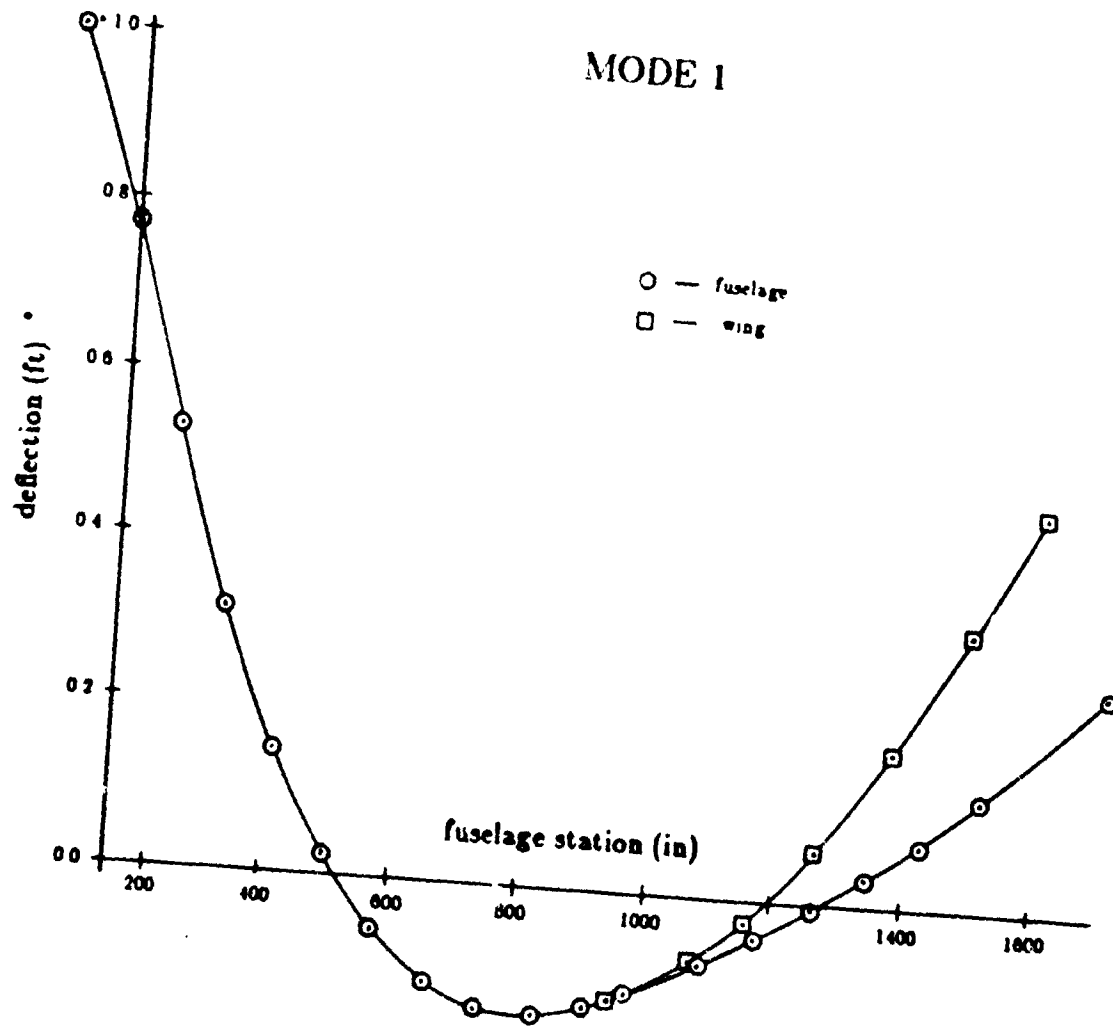


$\phi_1 \triangleq$ mode deflection (feet)

$\phi'_1 \triangleq$ mode slope (feet/feet)

$\eta_1 \triangleq$ generalized deflection (dimensionless)

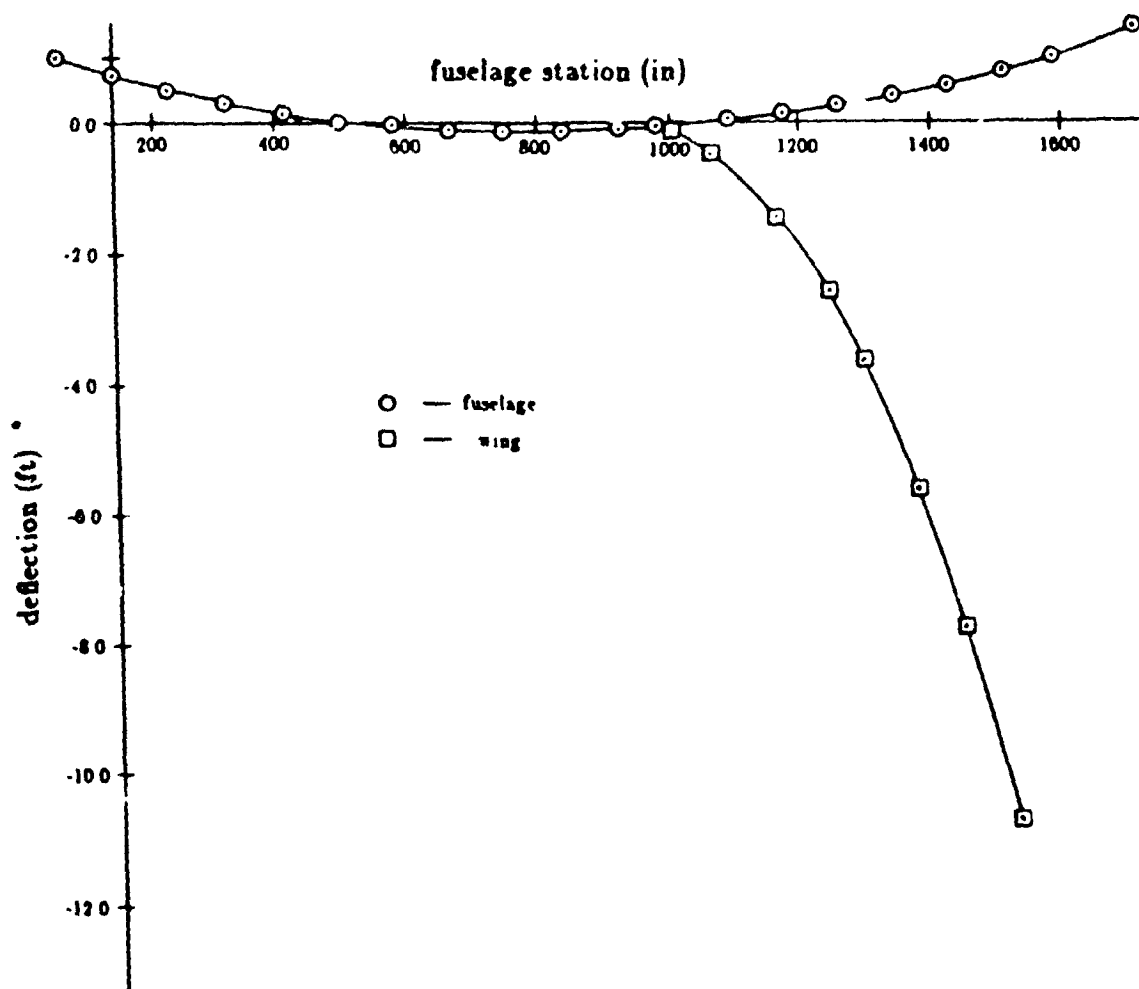
Figure A.4.1
Mode Shape Sign Conventions



* deflections are normalized to a one foot displacement at the nose

Figure A.4.2
Aeroelastic-Structural Mode Shape - Mode 1

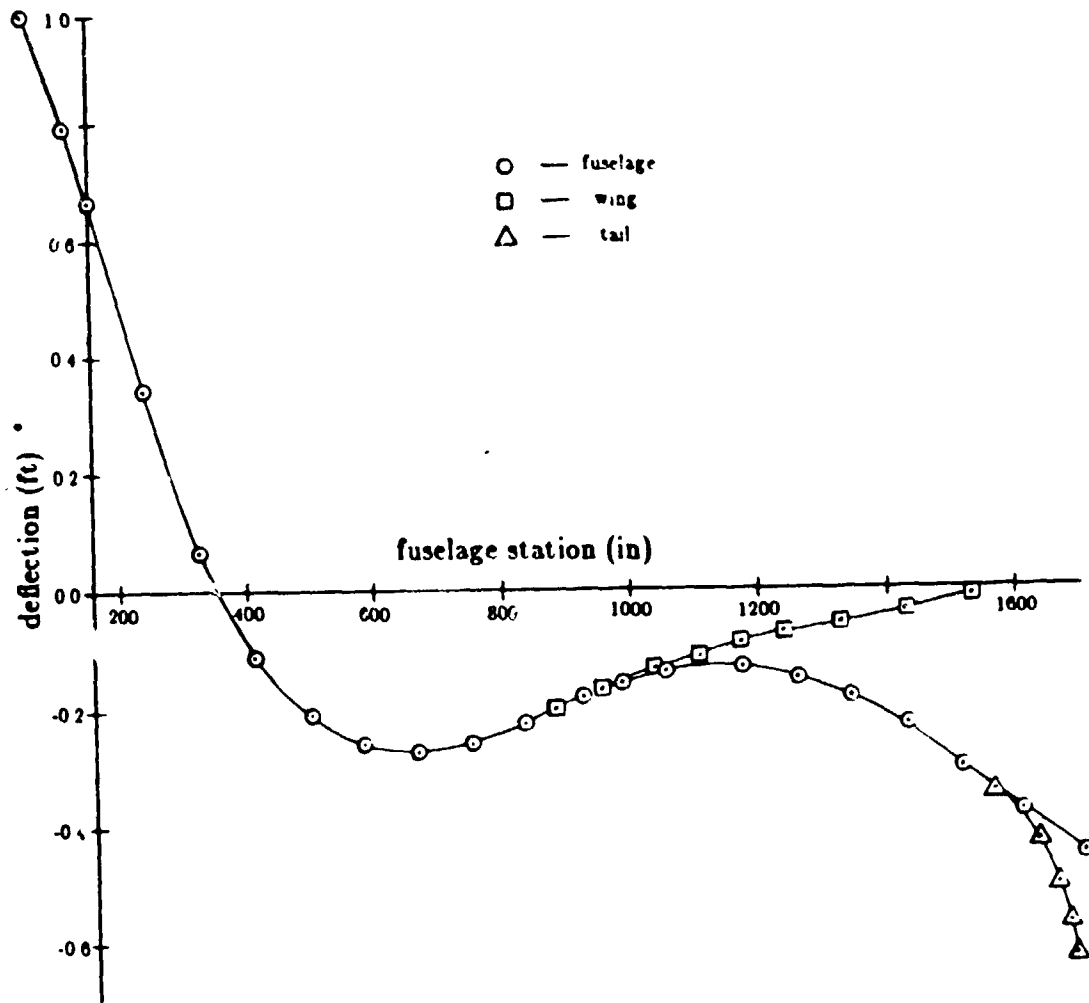
MODE 2



* deflections are normalized to a one foot displacement at the nose

Figure A.4.3
Aeroelastic-Structural Mode Shape - Mode 2

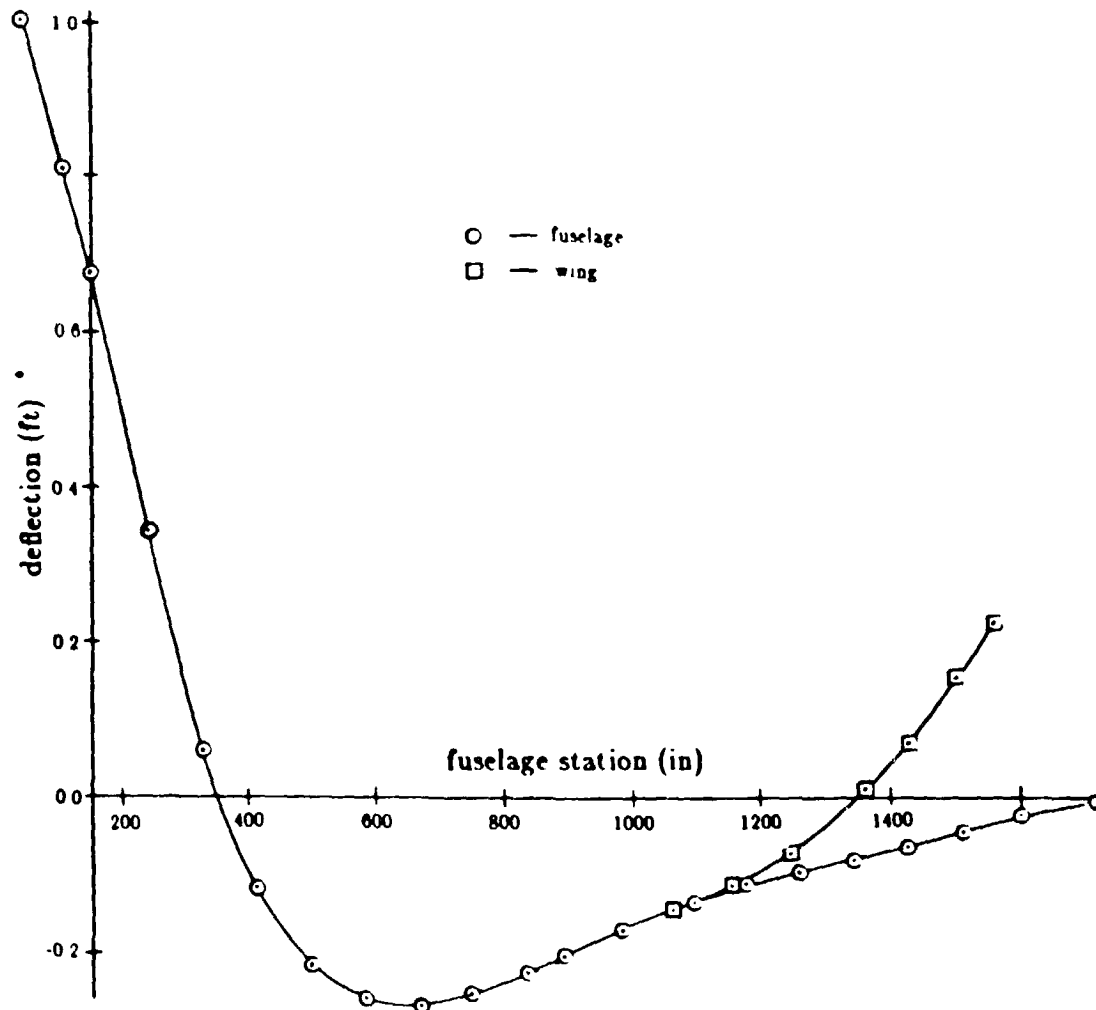
MODE 3



* deflections are normalized to a one foot displacement at the nose

Figure A.4.4
Aeroelastic-Structural Mode Shape - Mode 3

MODE 4



* deflections are normalized to a one foot displacement at the nose

Figure A.4.5
Aeroelastic-Structural Mode Shape - Mode 4

Appendix A.5
OCM Frequency Responses

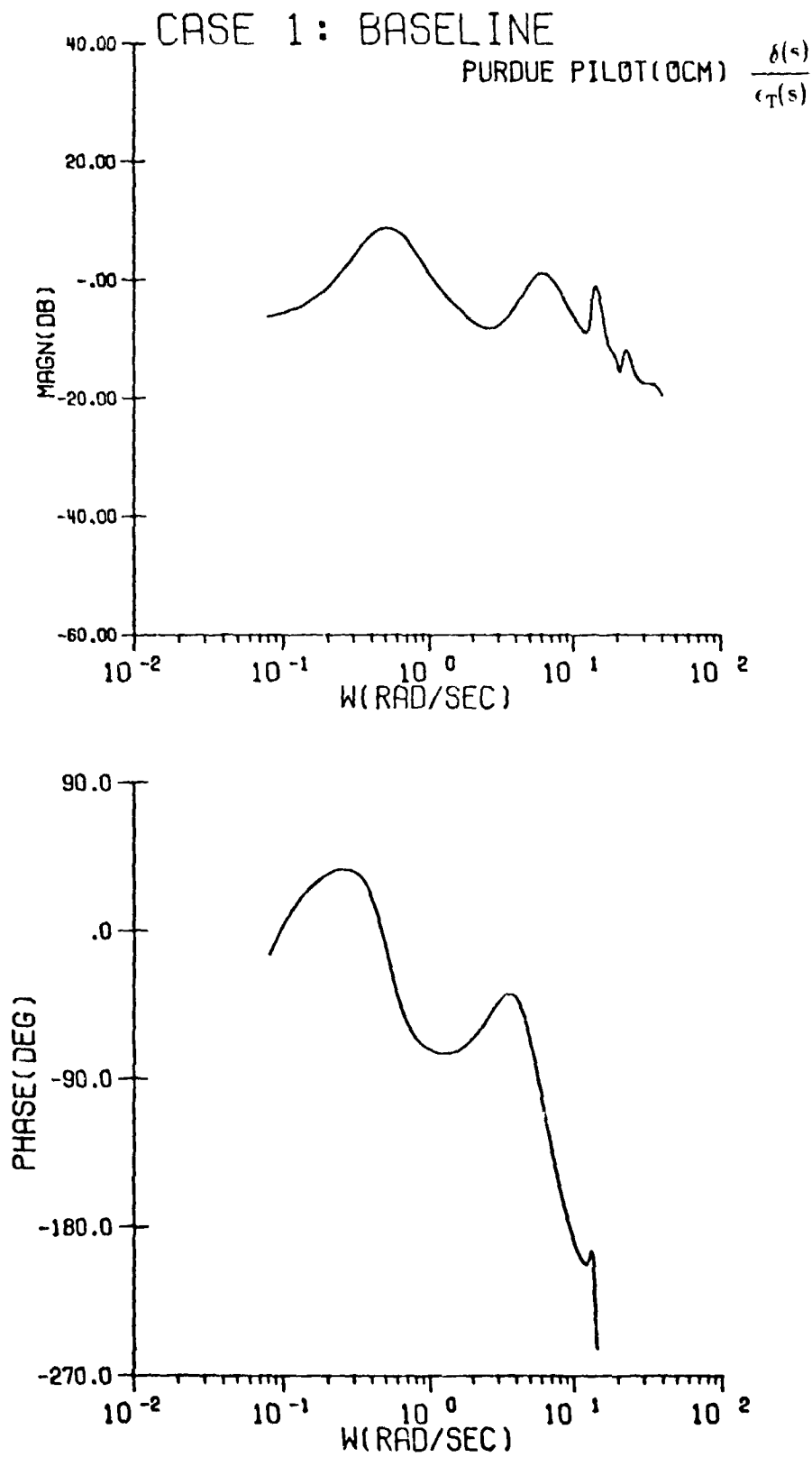


Figure A.5.1
OCM Frequency Responses - Config. 1

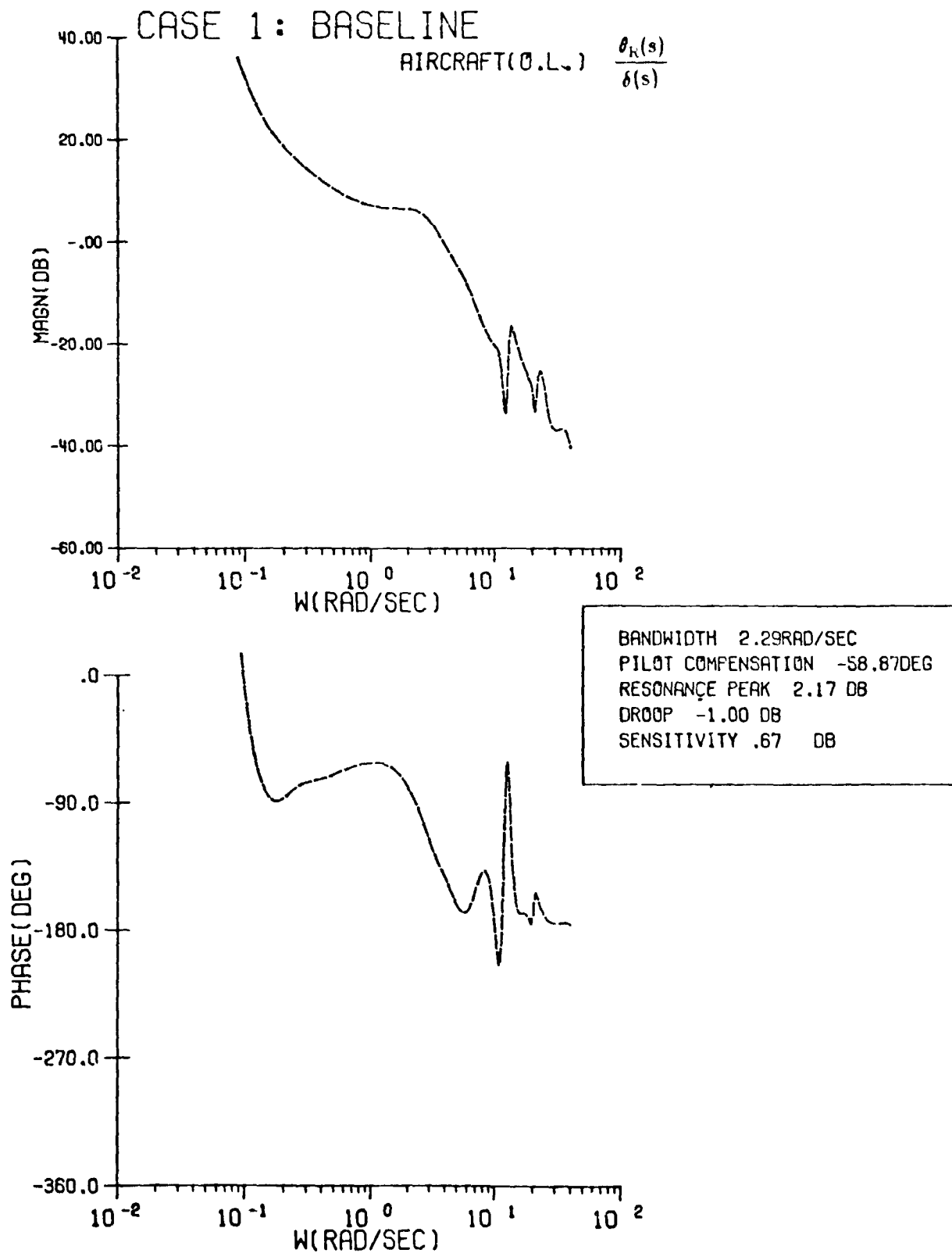


Figure A.5.1 (con't)
OCM Frequency Responses - Config. 1

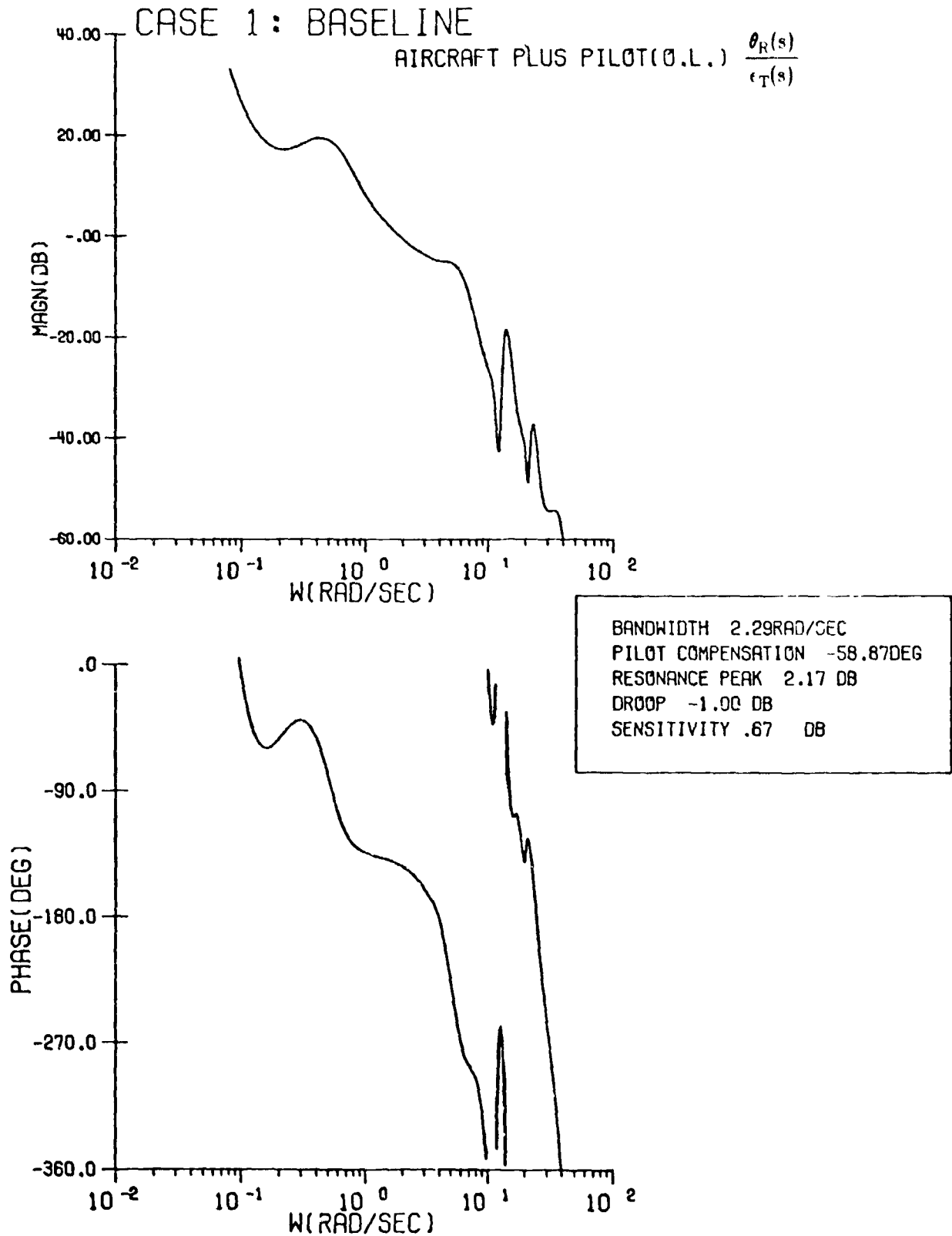


Figure A.5.1 (con't)
OCM Frequency Responses - Config. 1

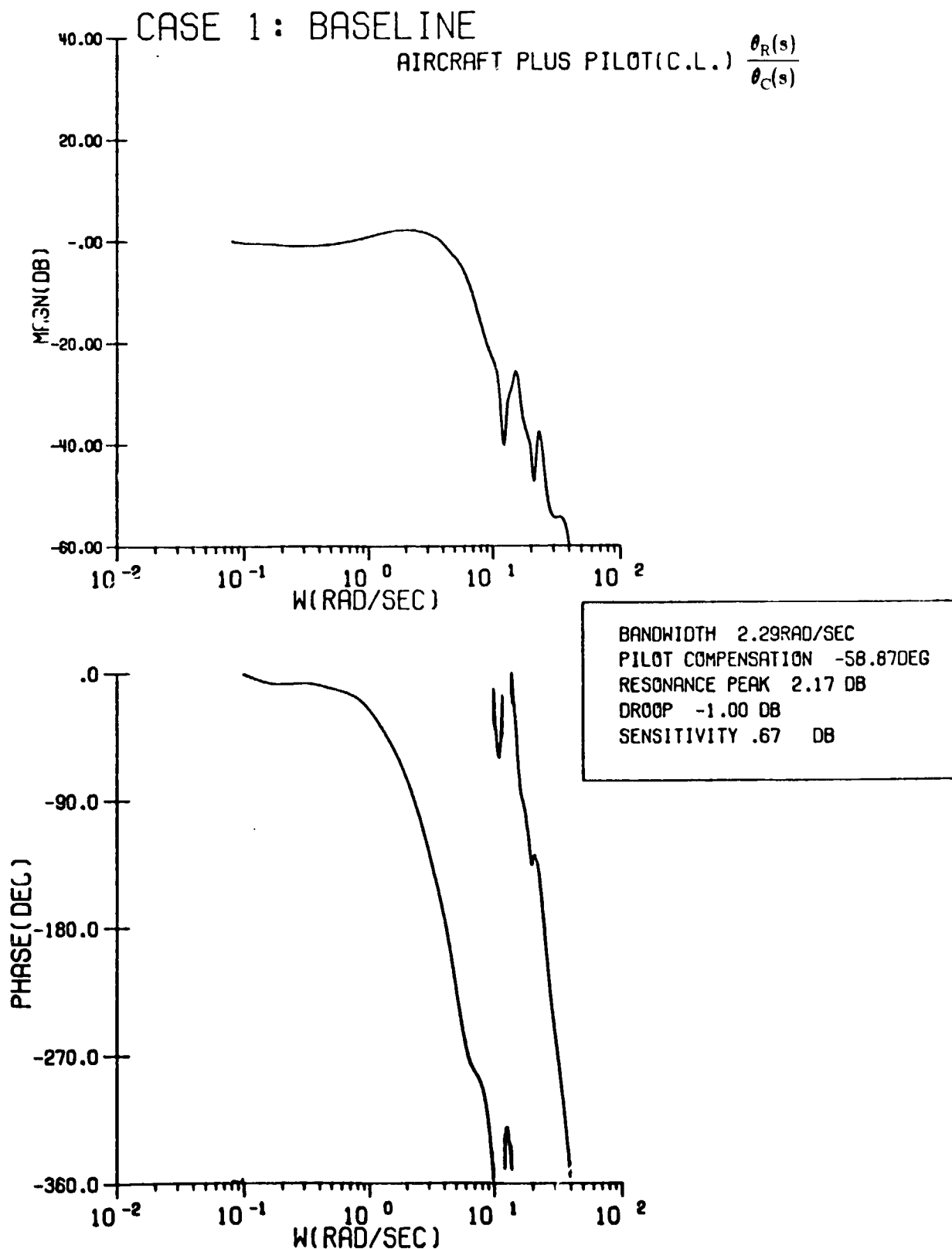


Figure A.5.1 (con't)
OCM Frequency Responses - Config. 1

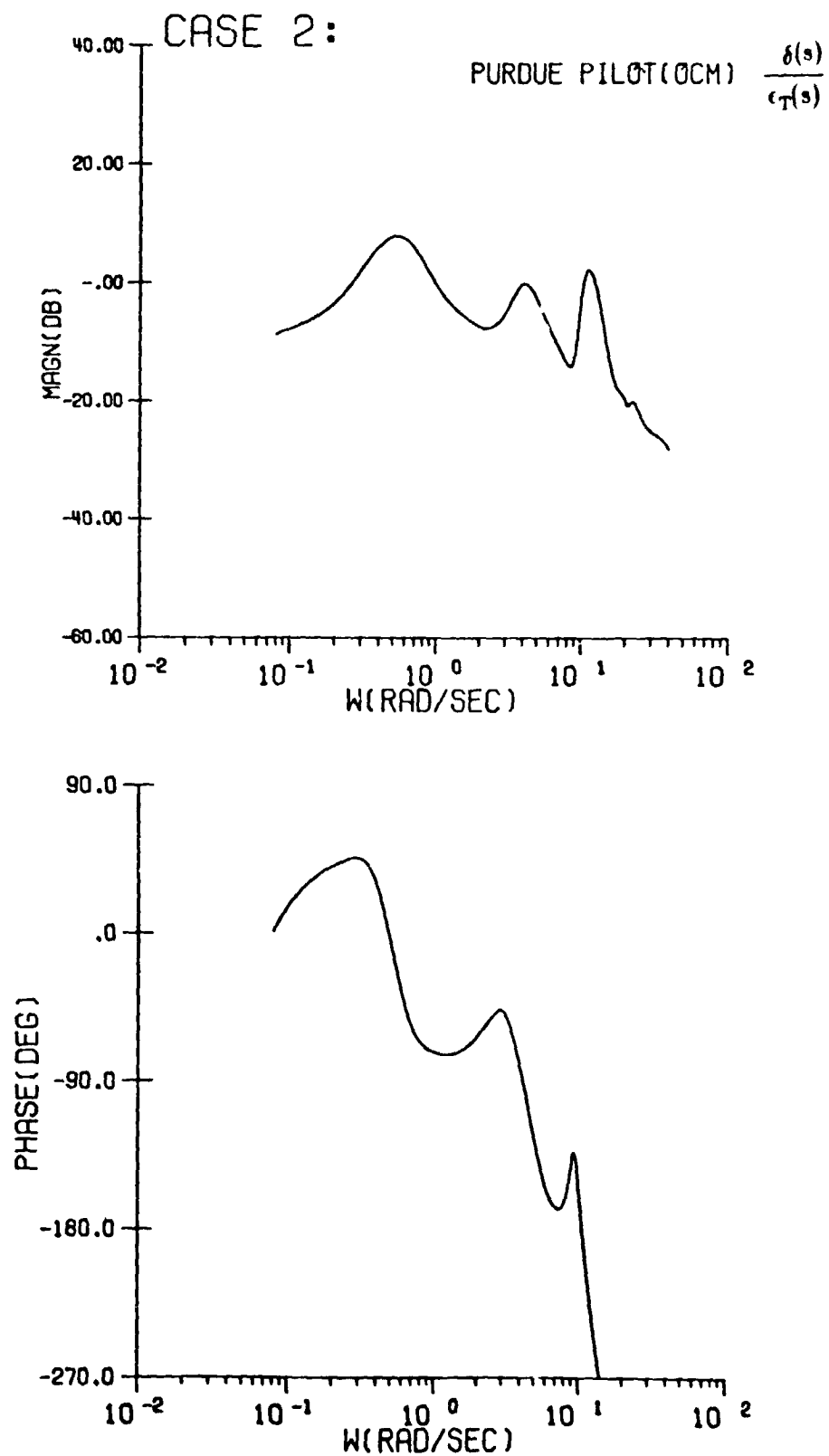


Figure A.5.2
OCM Frequency Responses - Config. 2

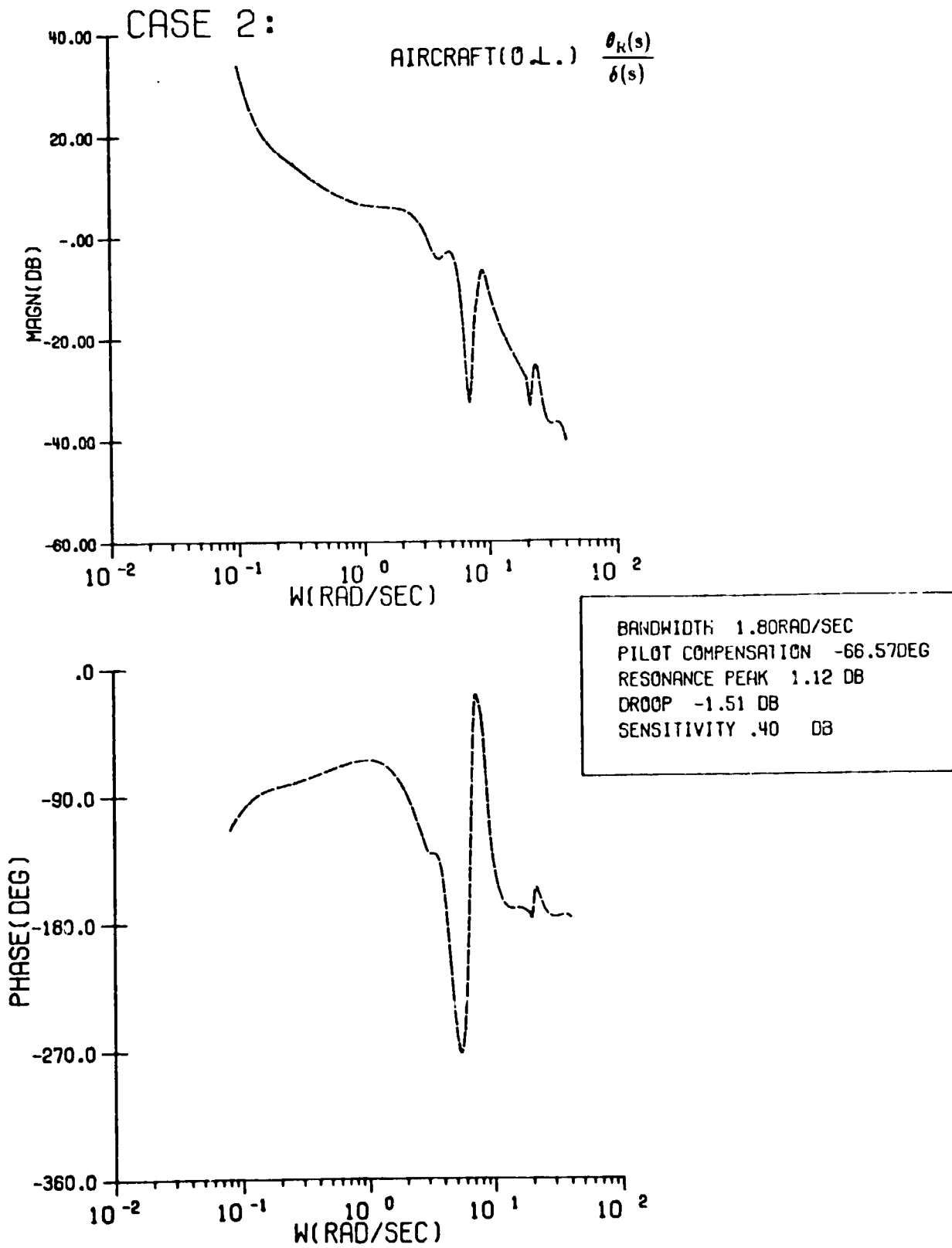


Figure A.5.2 (con't)
OCM Frequency Responses - Config. 2

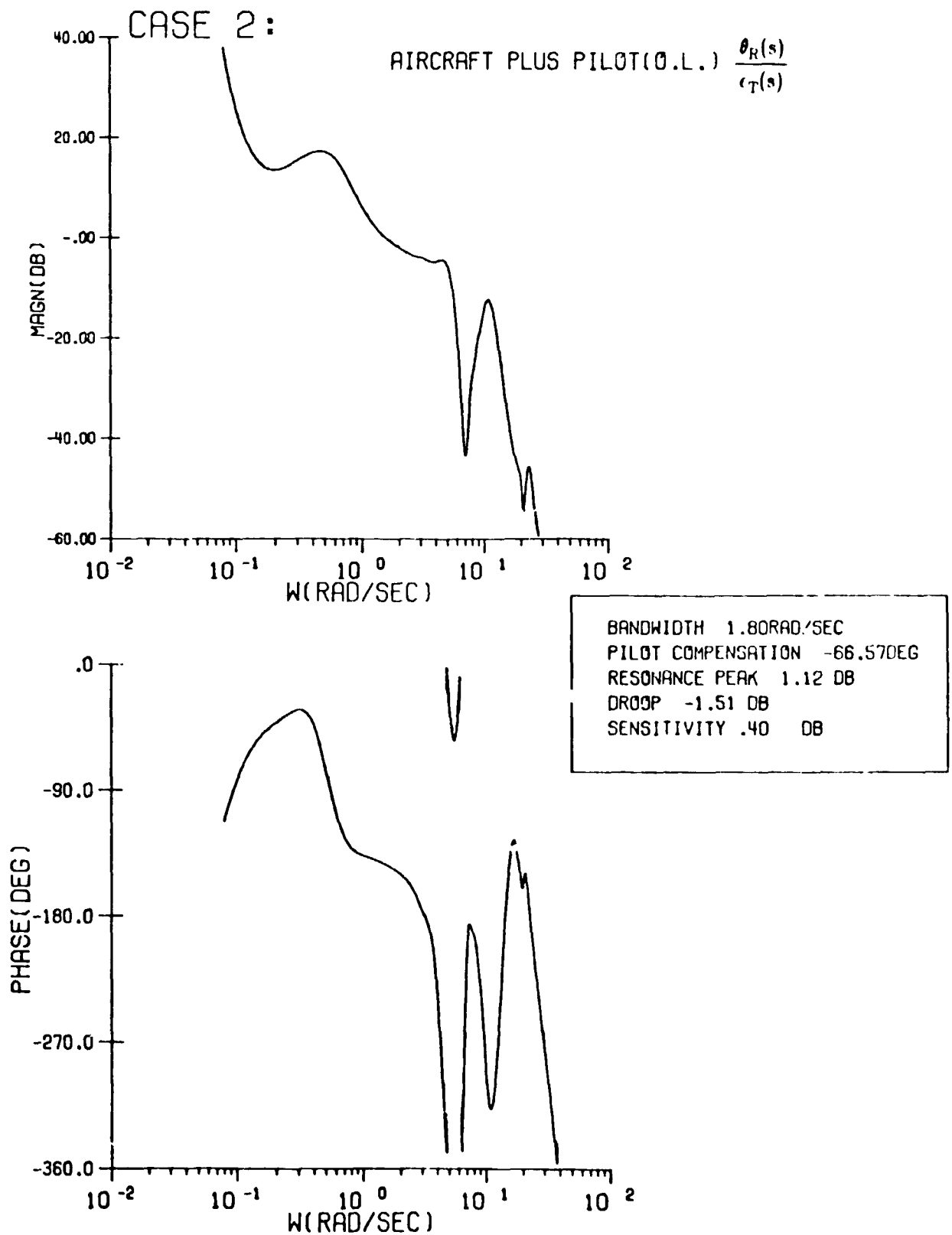


Figure A.5.2 (con't)
OCM Frequency Responses - Config. 2

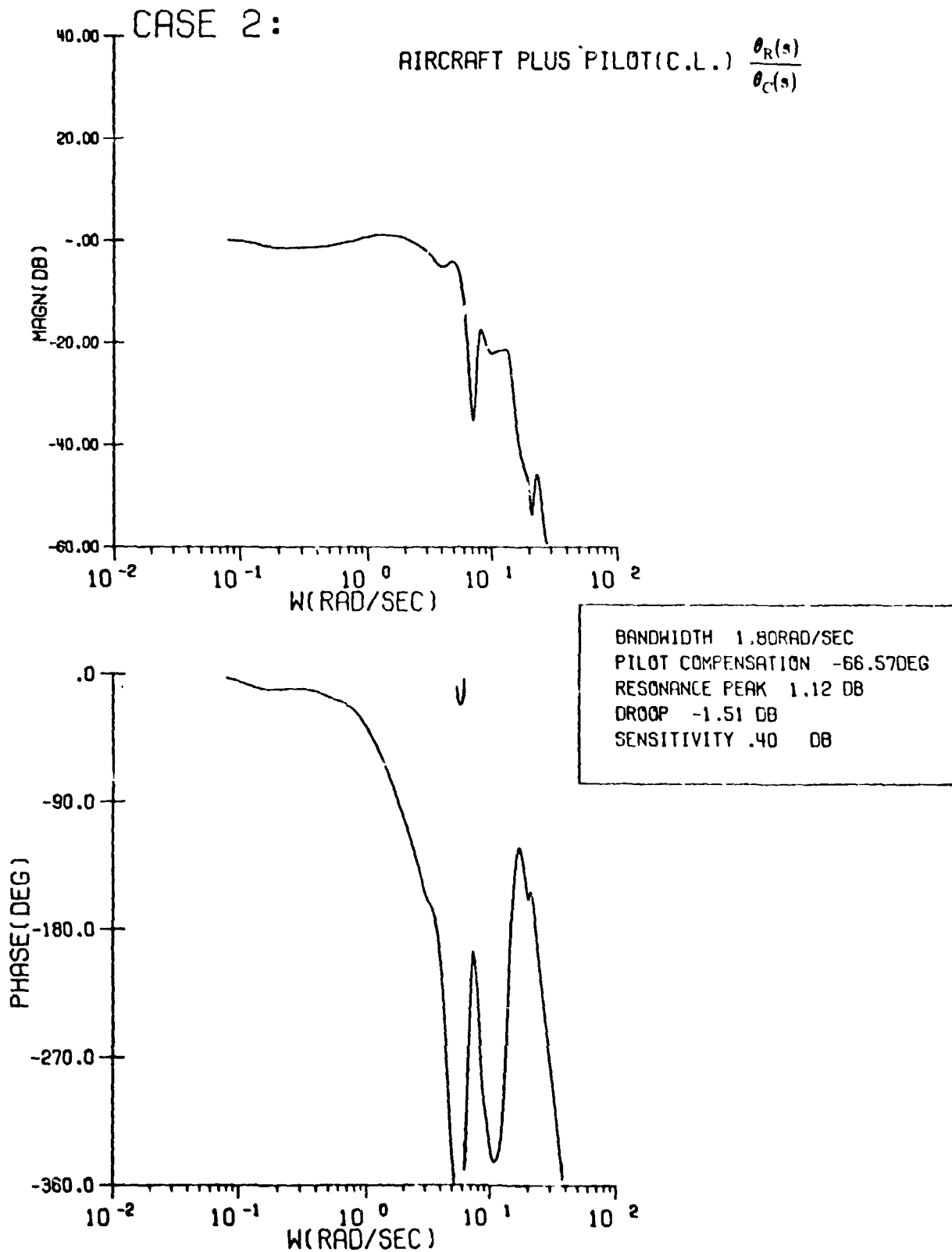


Figure A.5.2 (con't)
OCM Frequency Responses - Config. 2

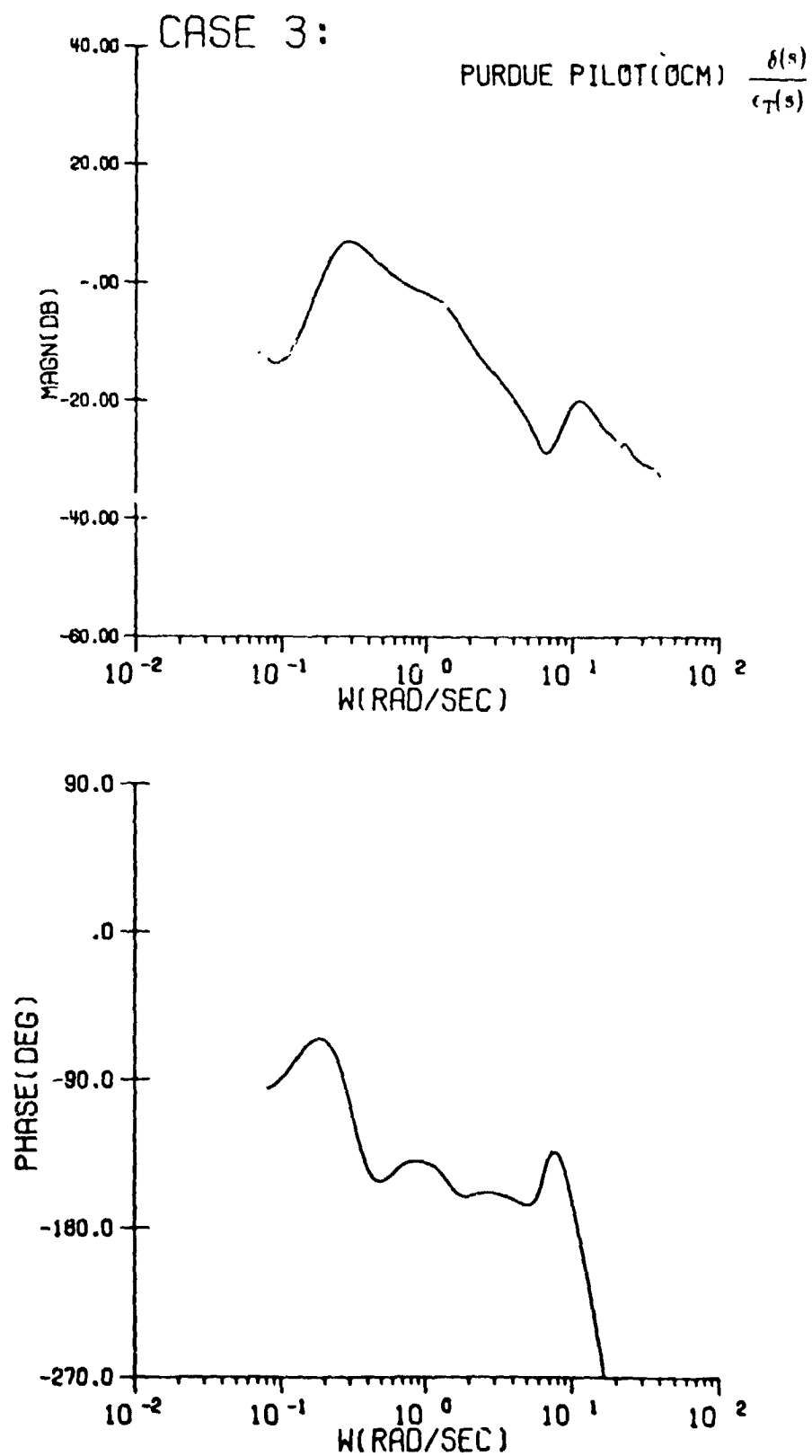


Figure A.5.3
OCM Frequency Responses - Config. 3

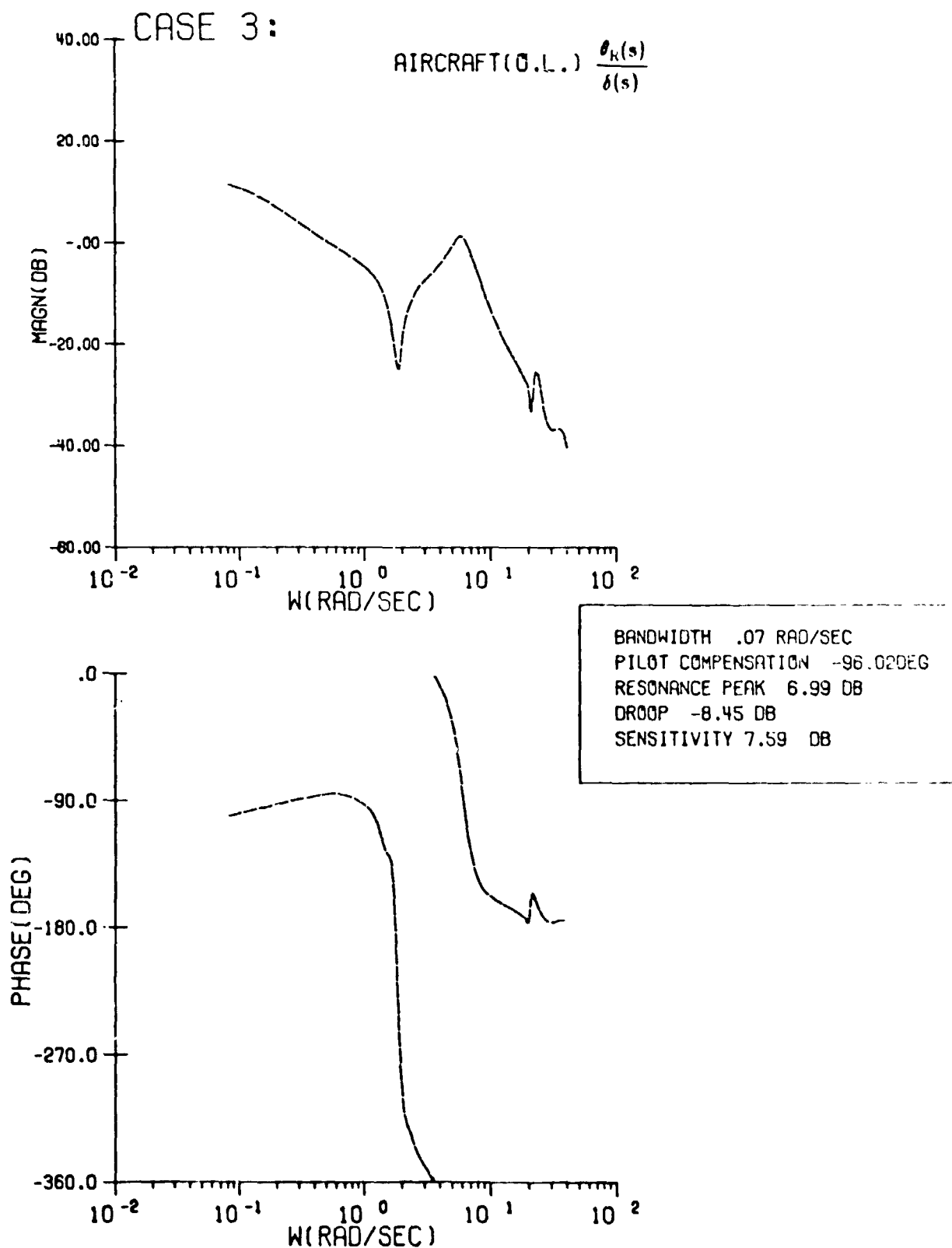


Figure A.5.3 (con't)
OCM Frequency Responses - Config. 3

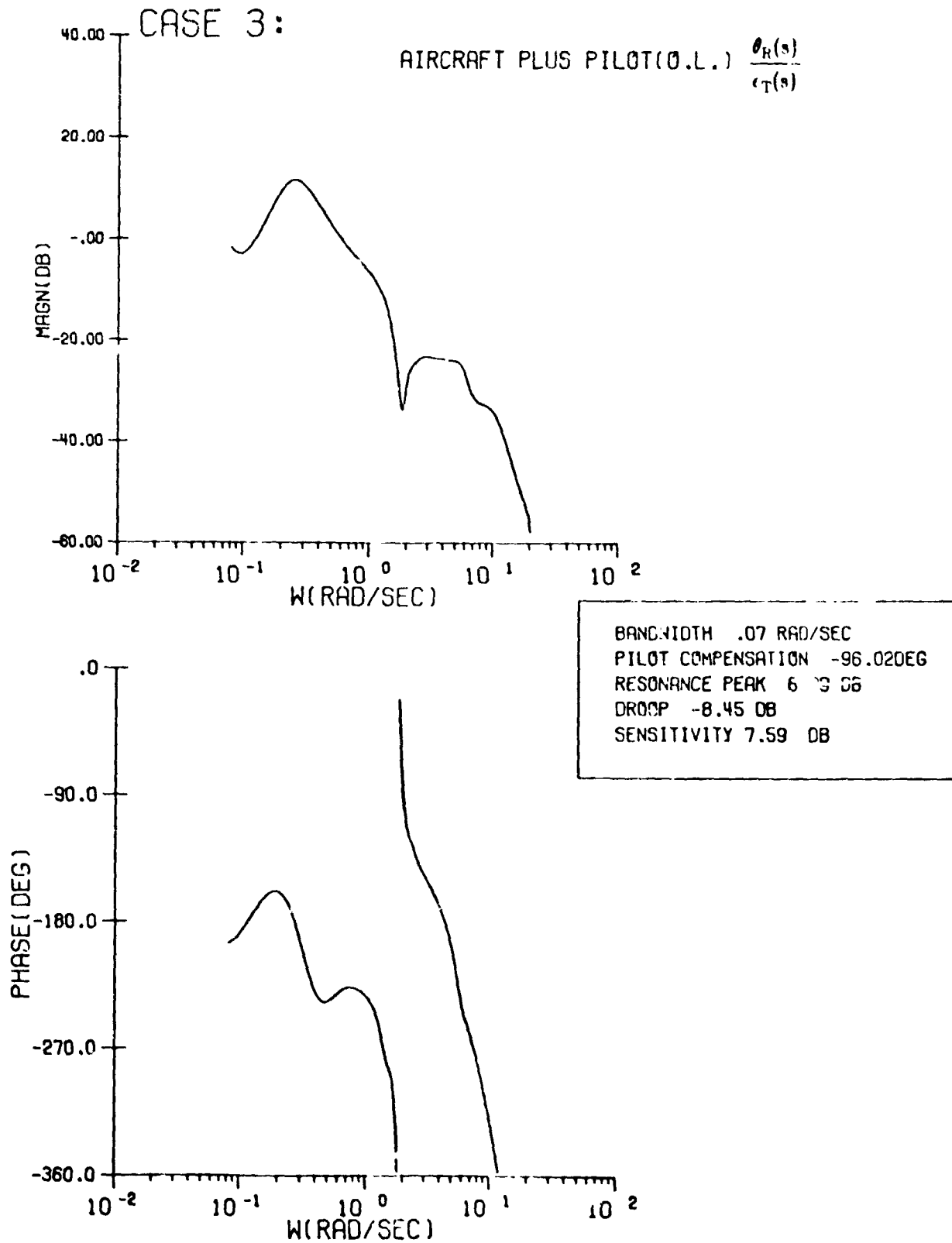


Figure A.5.3 (con't)
OCM Frequency Responses - Config 3

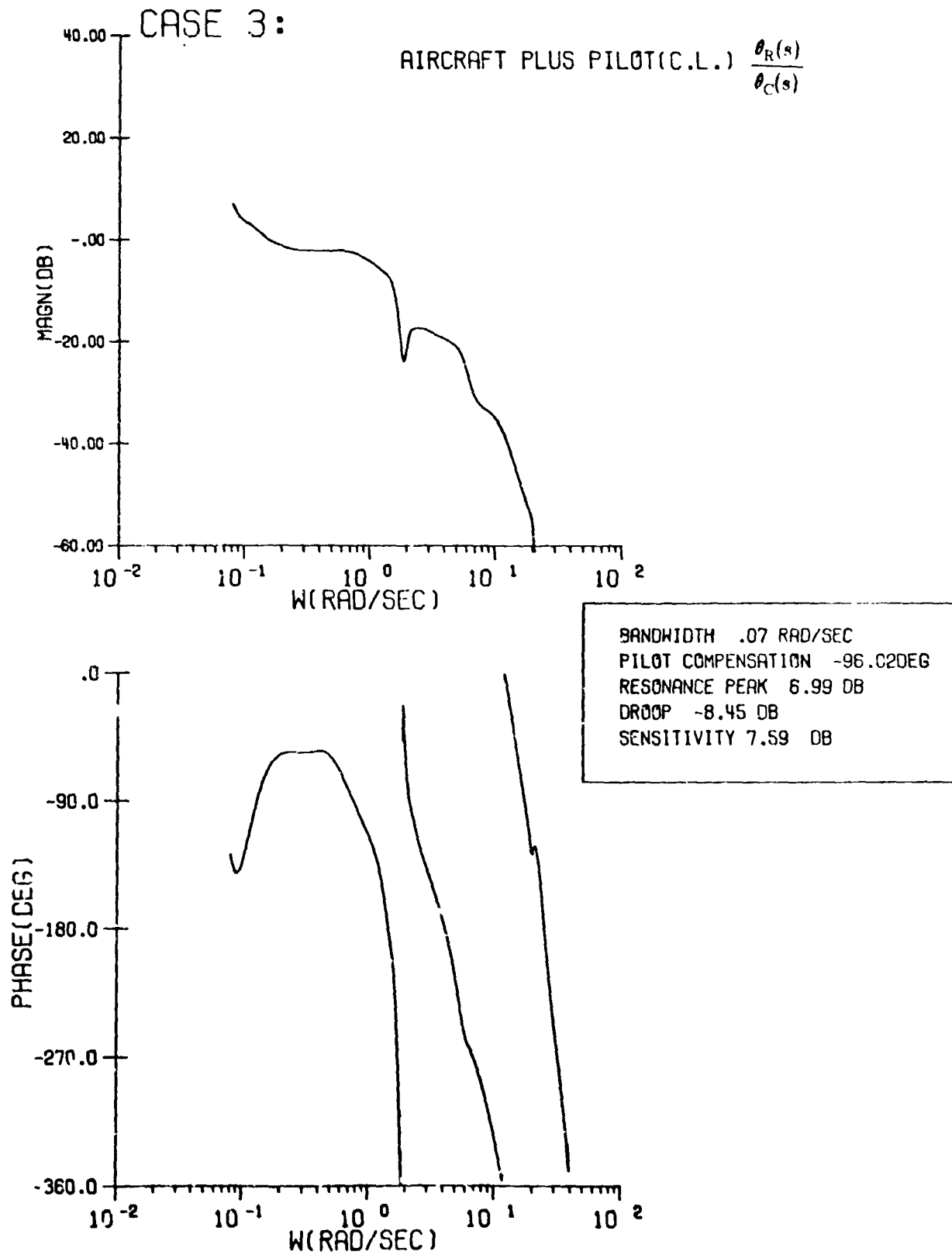


Figure A.2 (con't)
OCM Frequency Responses - Config. 3

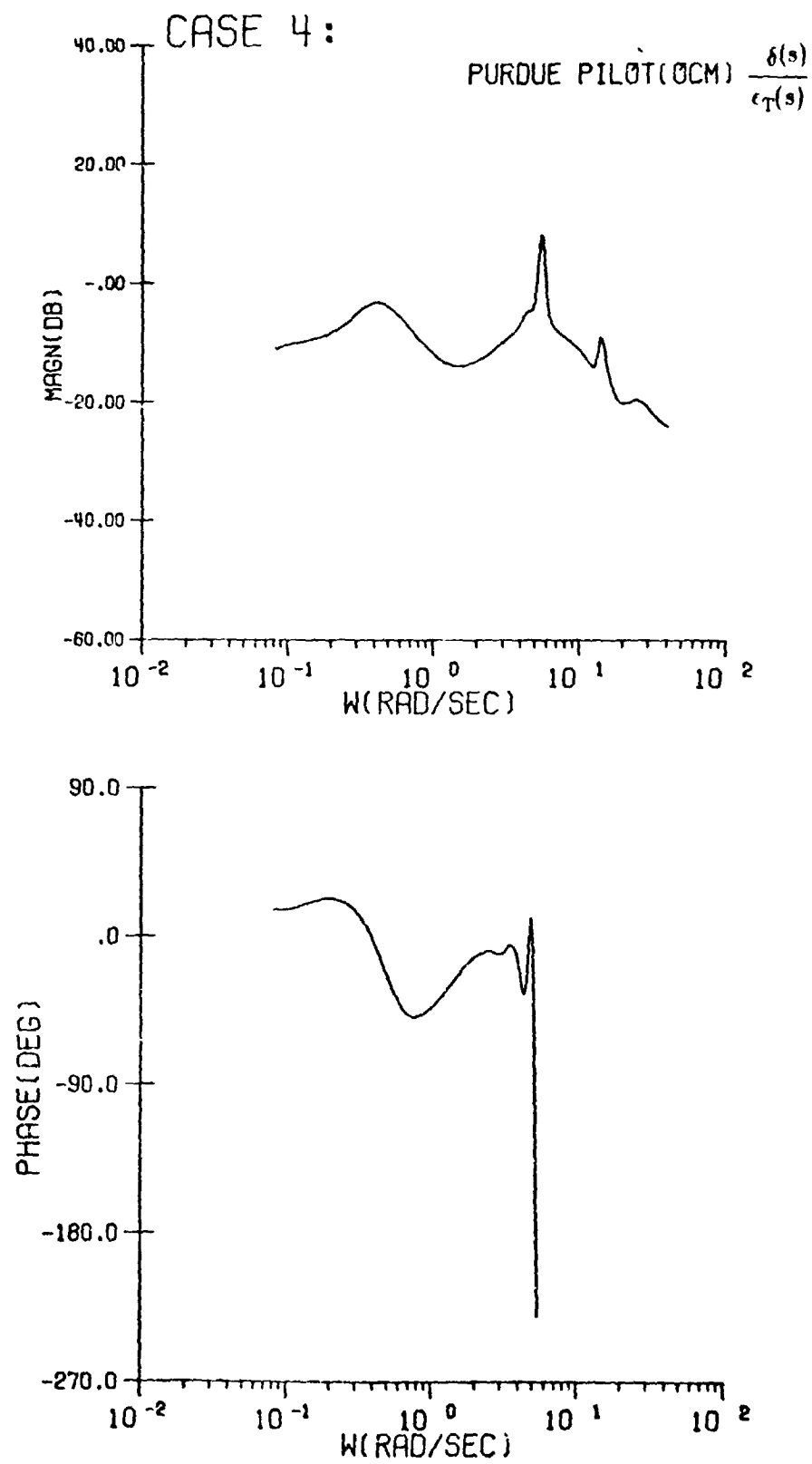


Figure A.5.4
OCM Frequency Responses - Config. 4

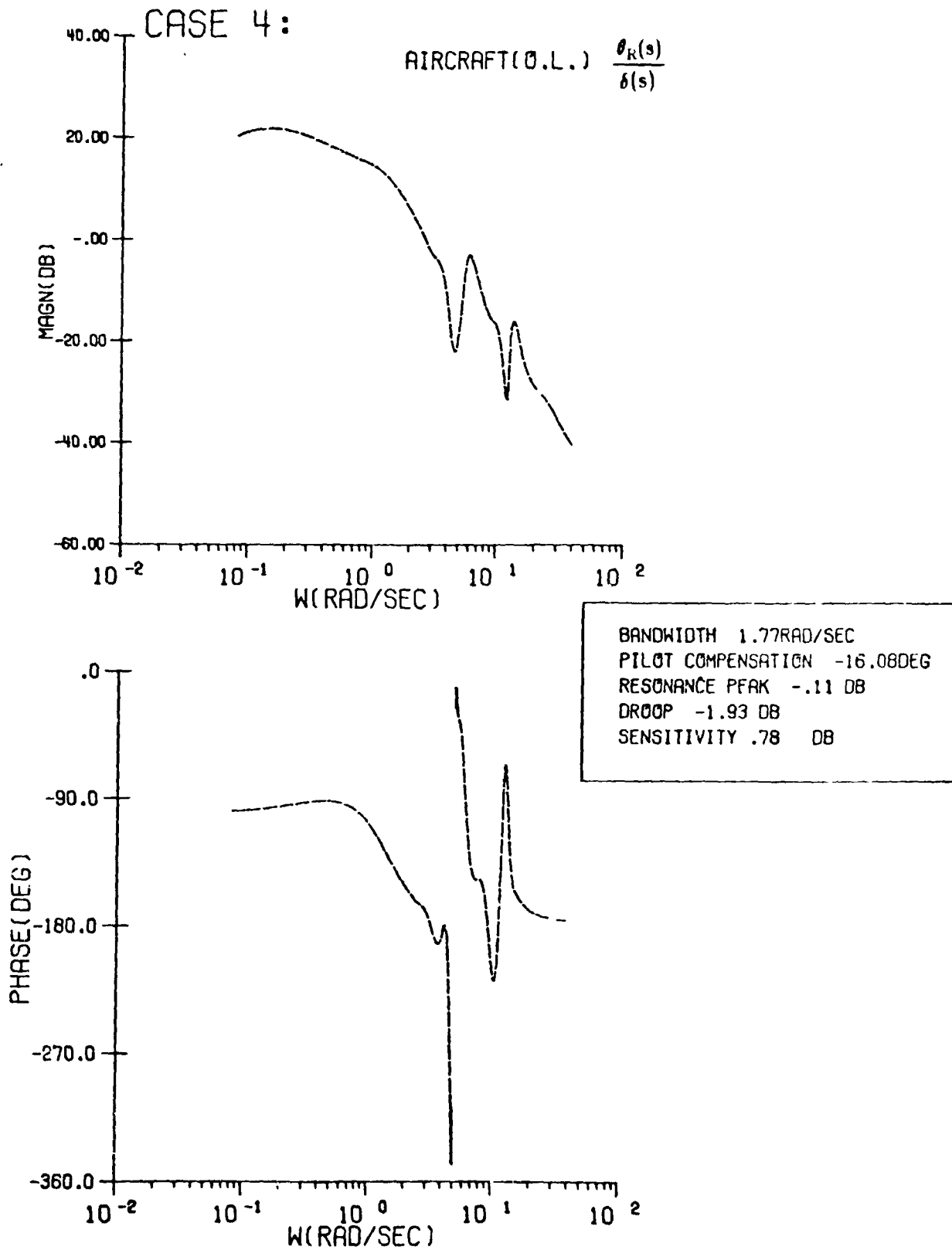


Figure A.5.4 (con't)
OCM Frequency Responses - Config. 4

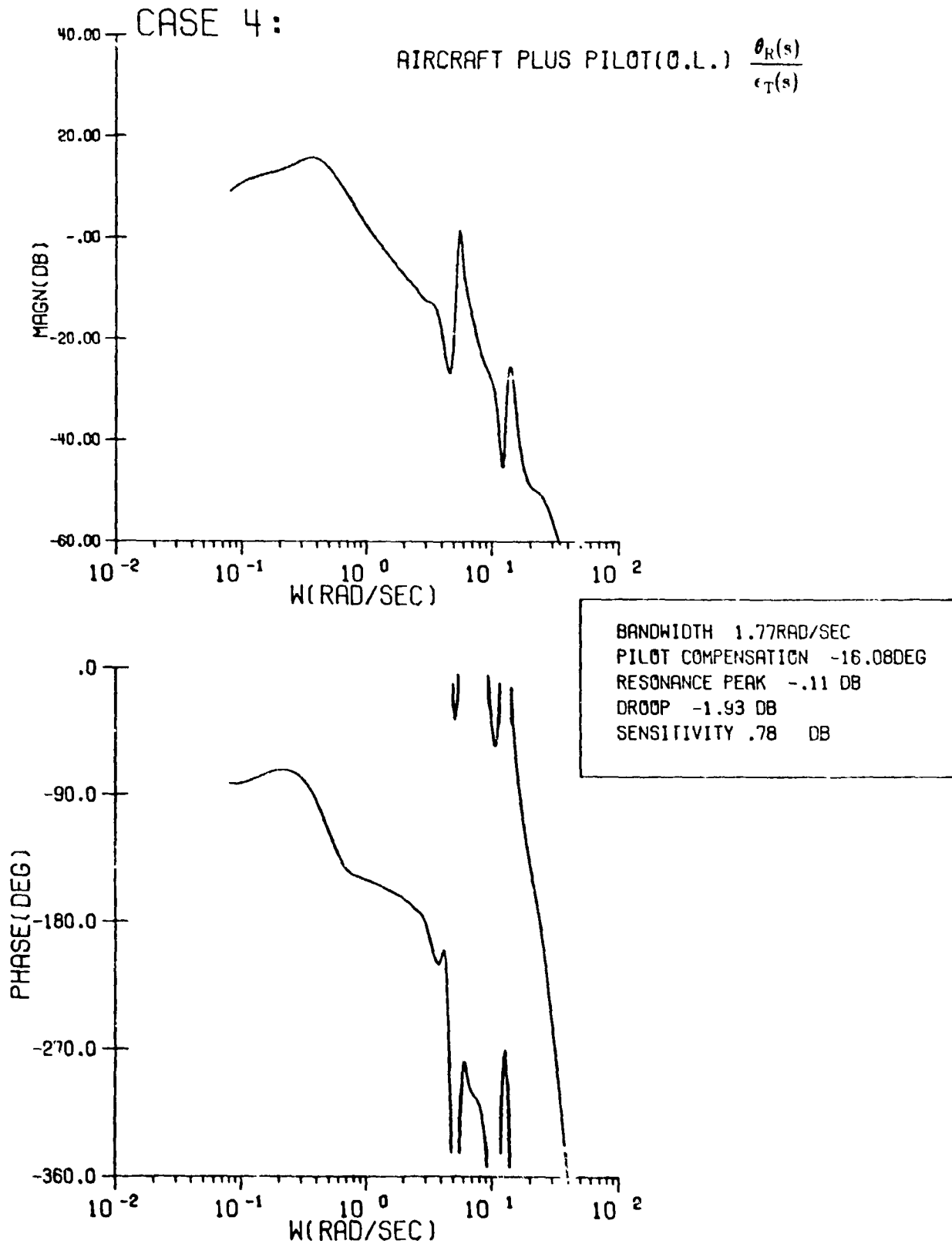


Figure A.5.4 (con't)
OCM Frequency Responses - Config. 4

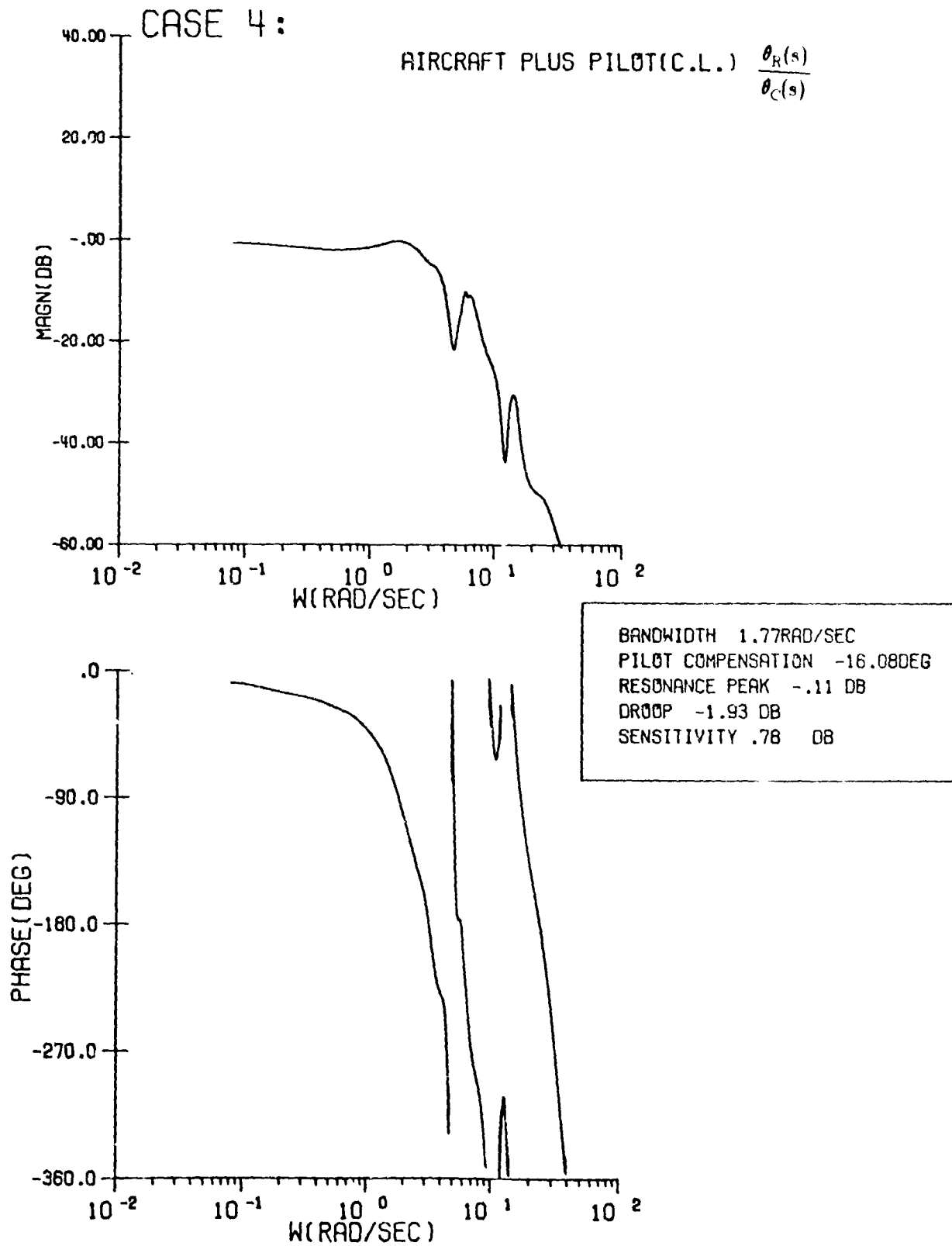


Figure A.5.4 (con't)
OCM Frequency Responses - Config. 4

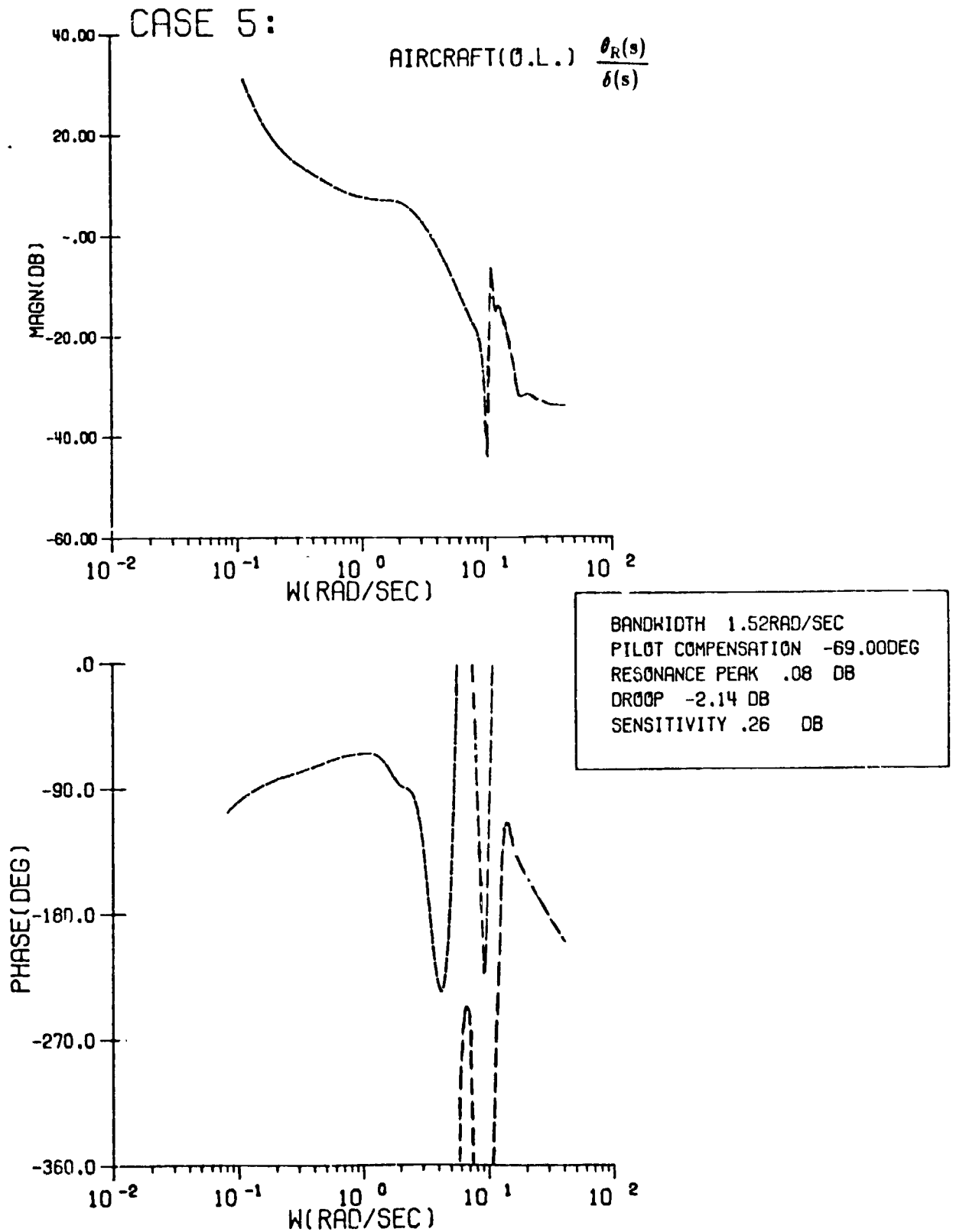


Figure A.5.5 (con't)
OCM Frequency Responses - Config. 5

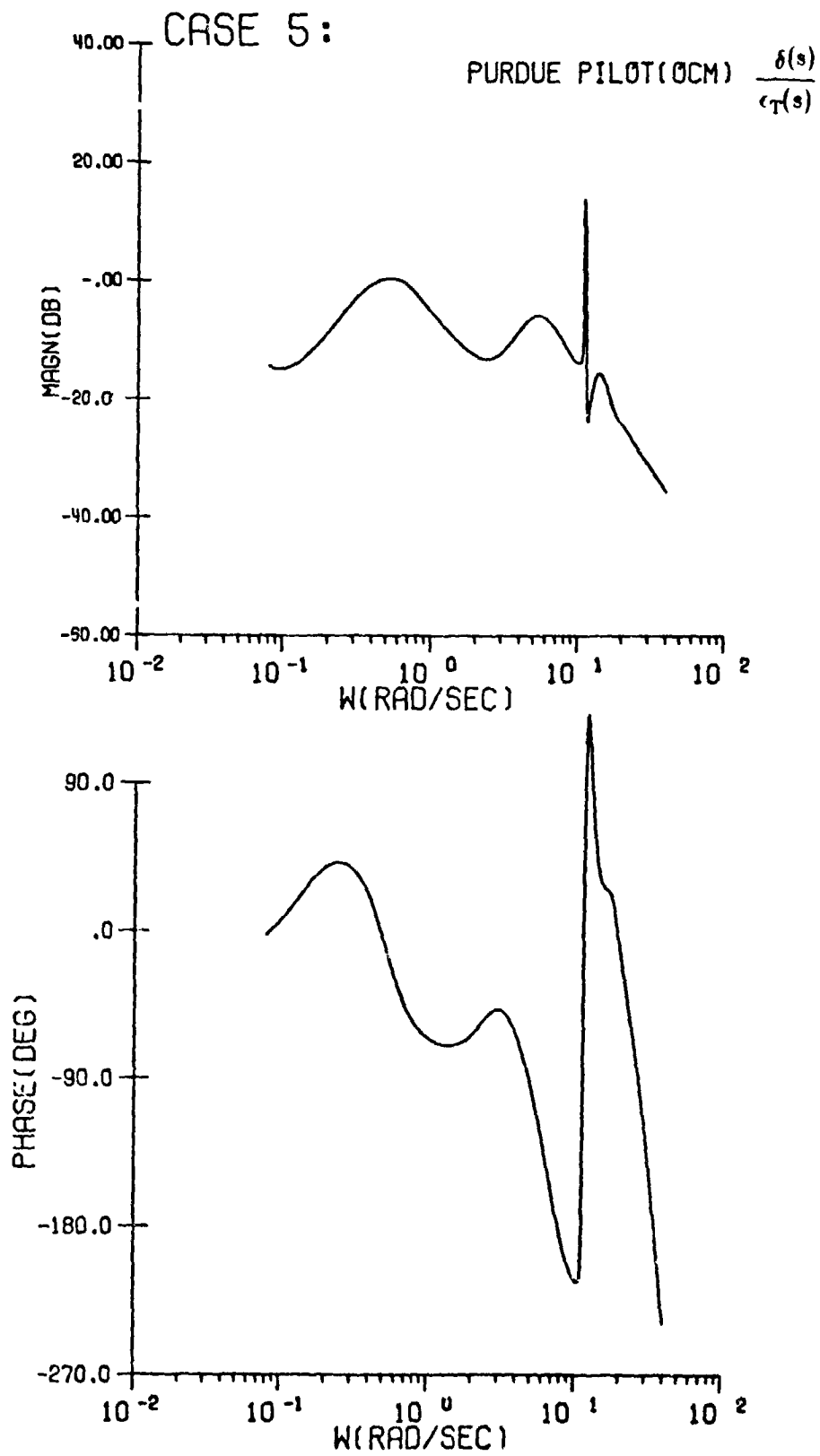


Figure A.5.5
OCM Frequency Responses - Config. 5

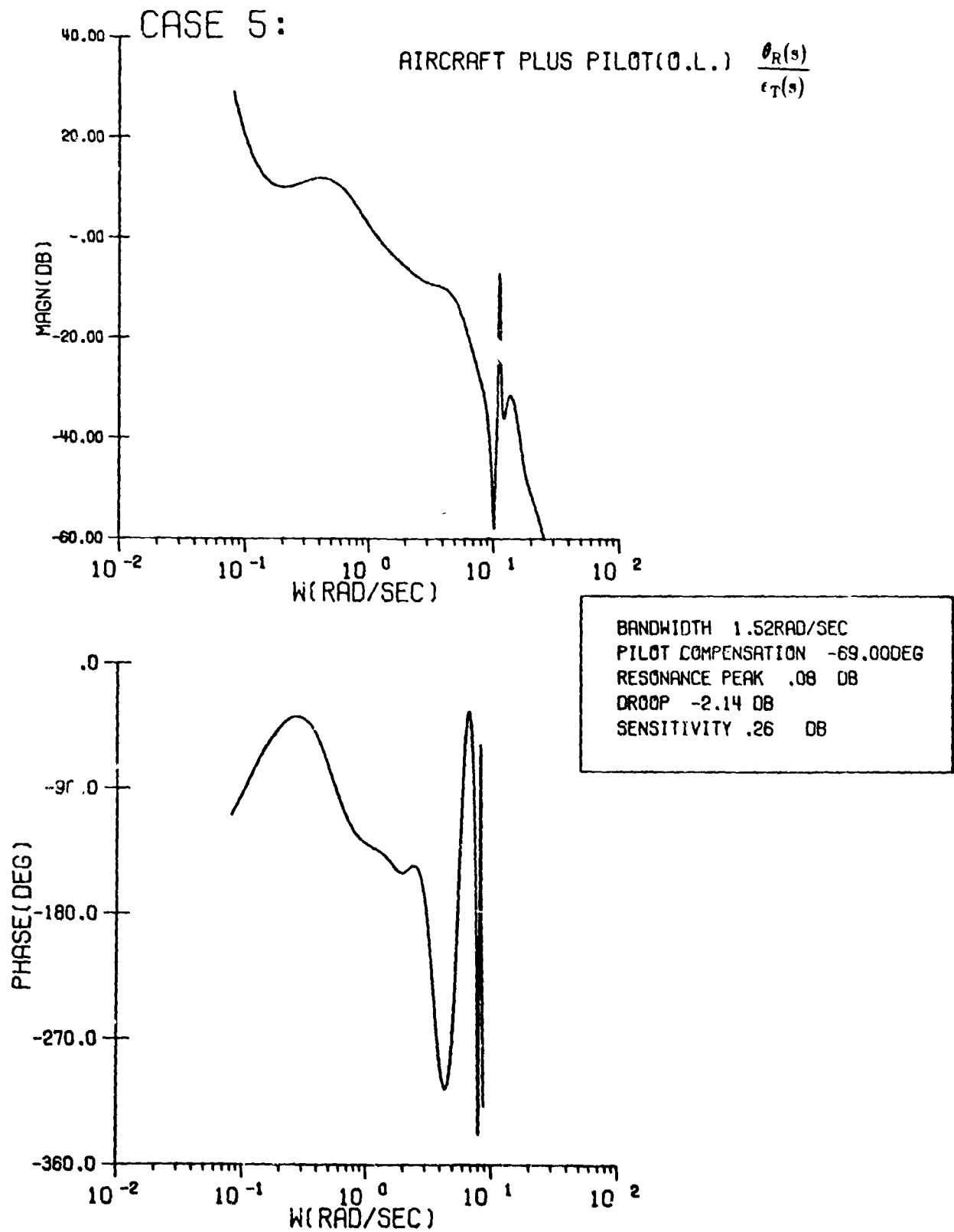


Figure A.5.5 (con't)
OCM Frequency Responses - Config. 5

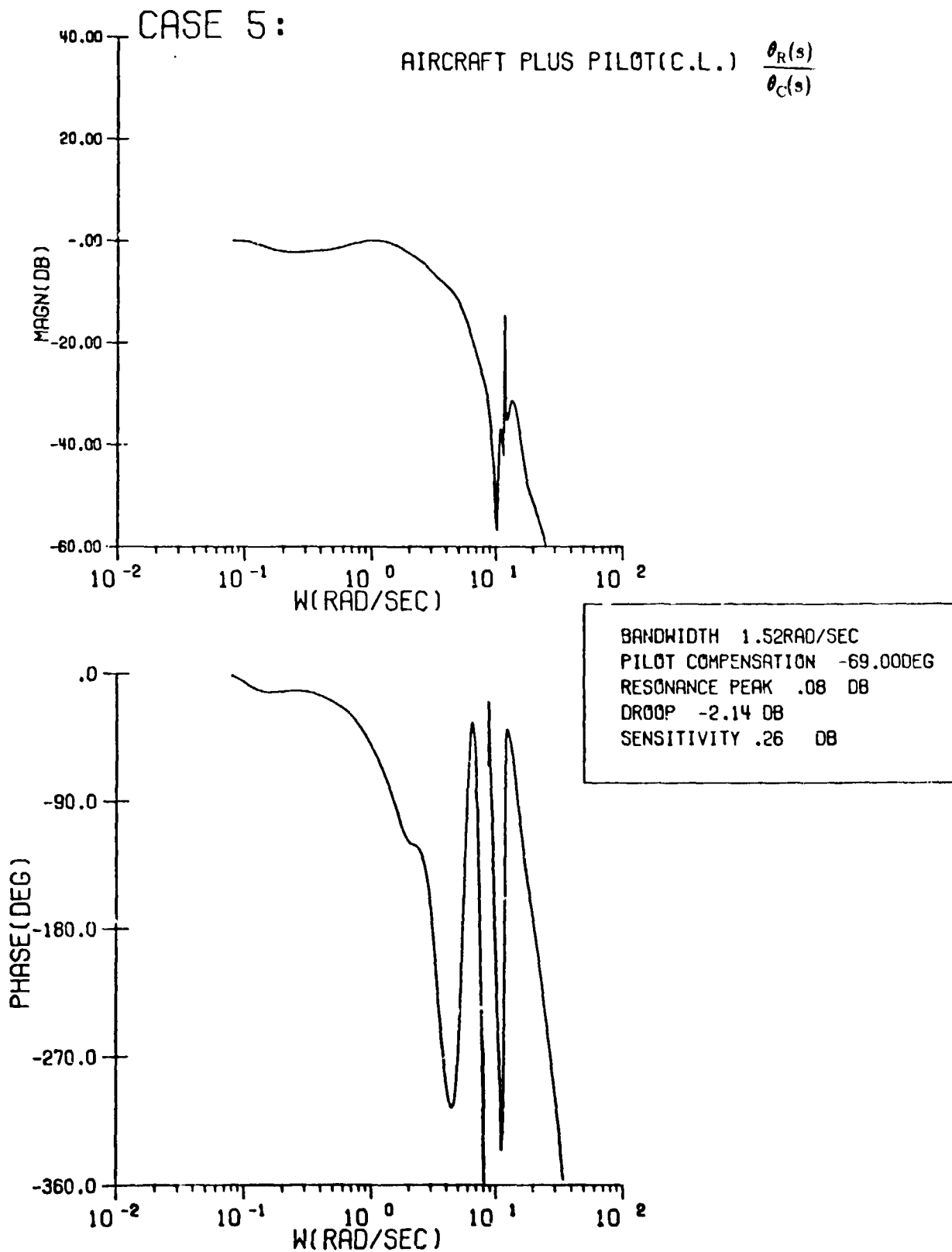


Figure A.5.5 (con't)
OCM Frequency Responses - Config. 5

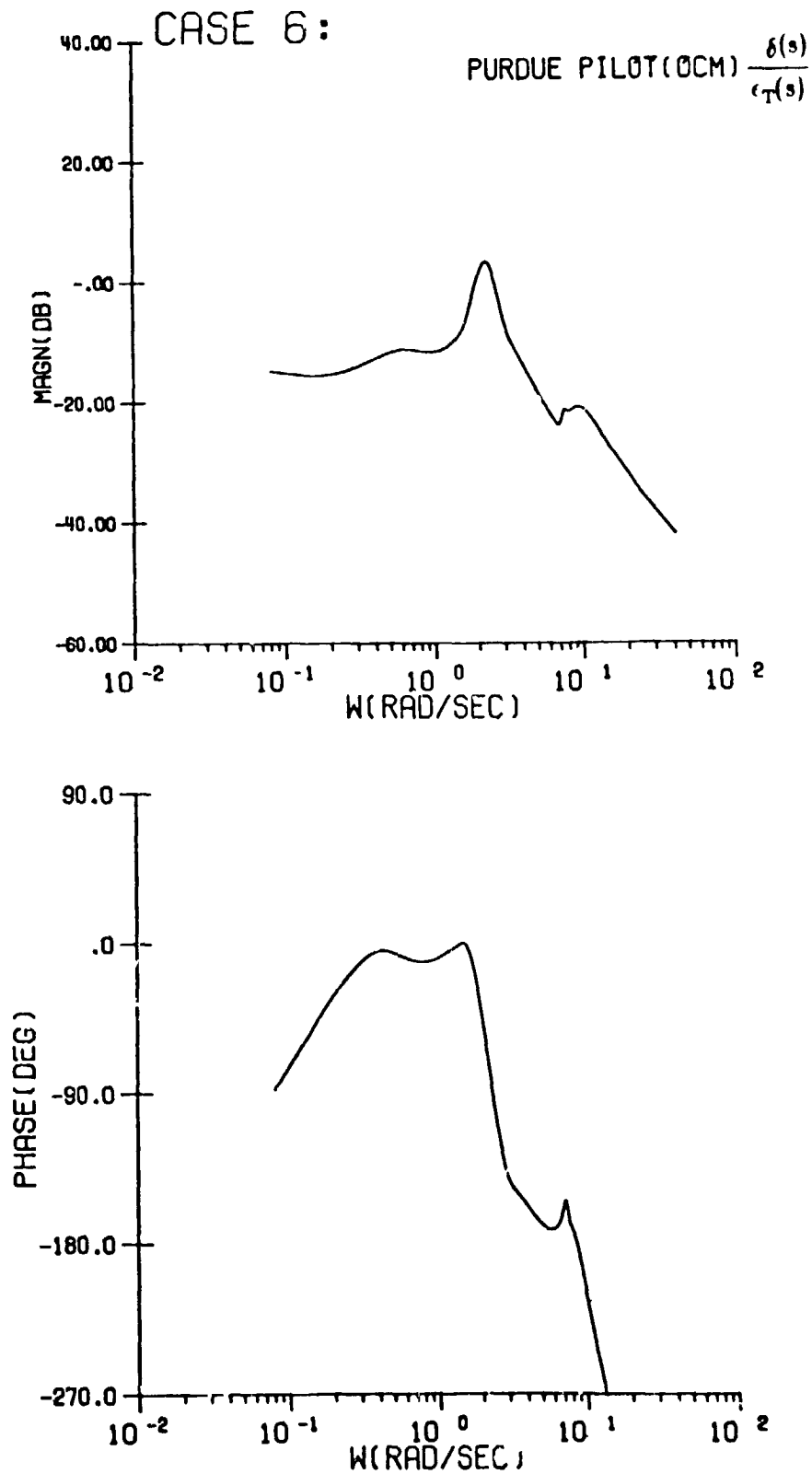


Figure A.5.6
OCM Frequency Responses - Config. 6

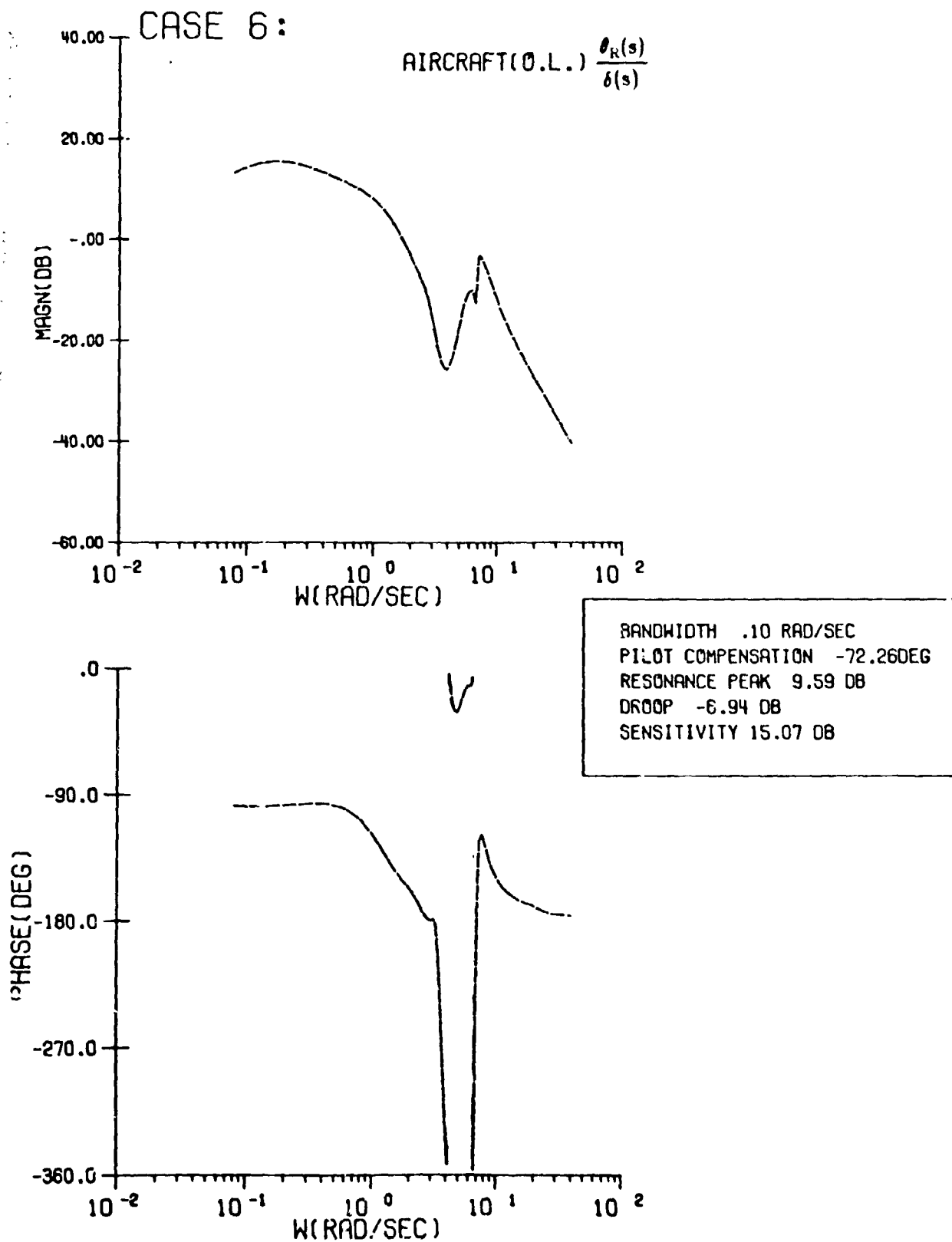


Figure A.5.6 (con't)
 OCM Frequency Responses - Config. 6

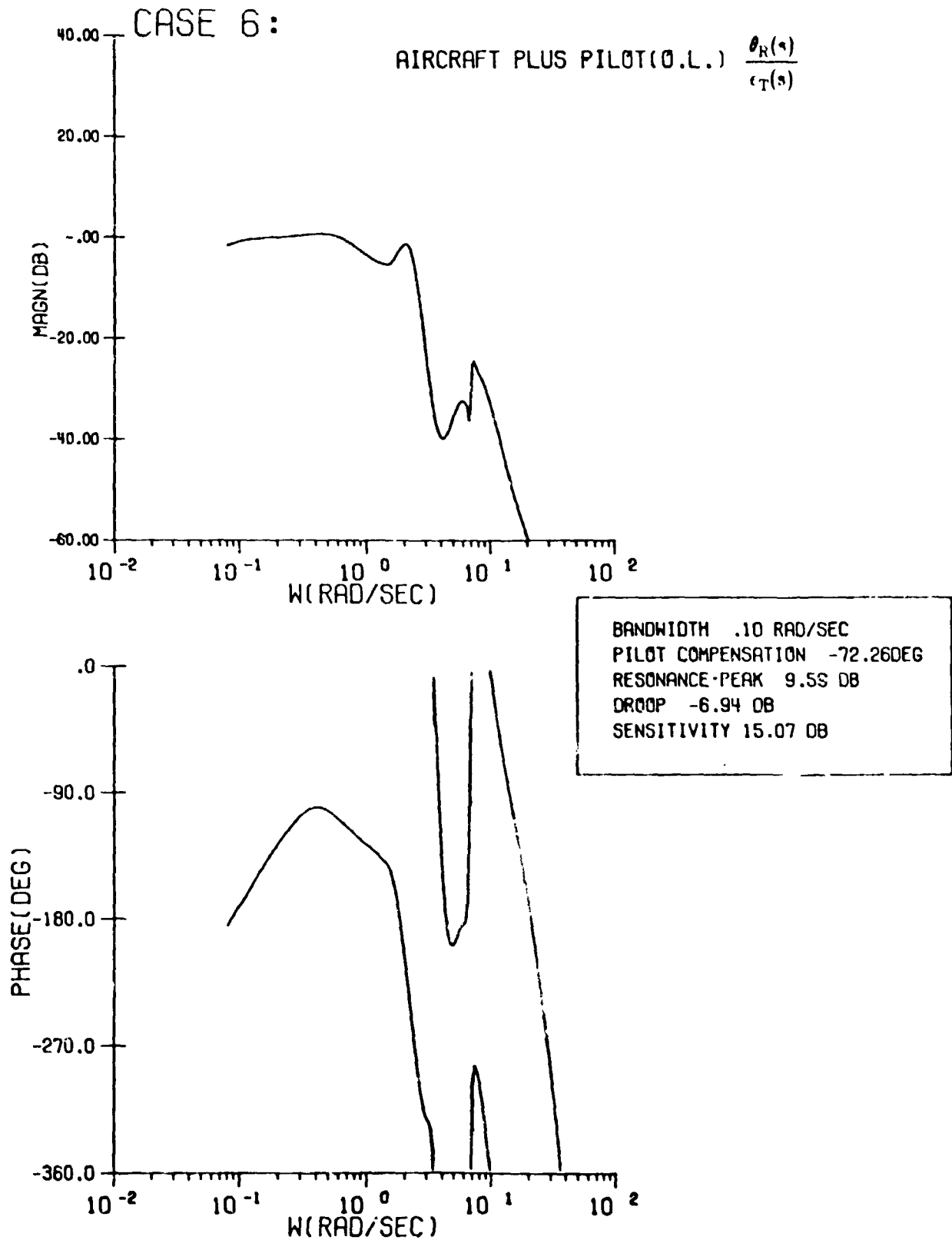


Figure A.5.6 (con't)
OCM Frequency Responses - Config. 6

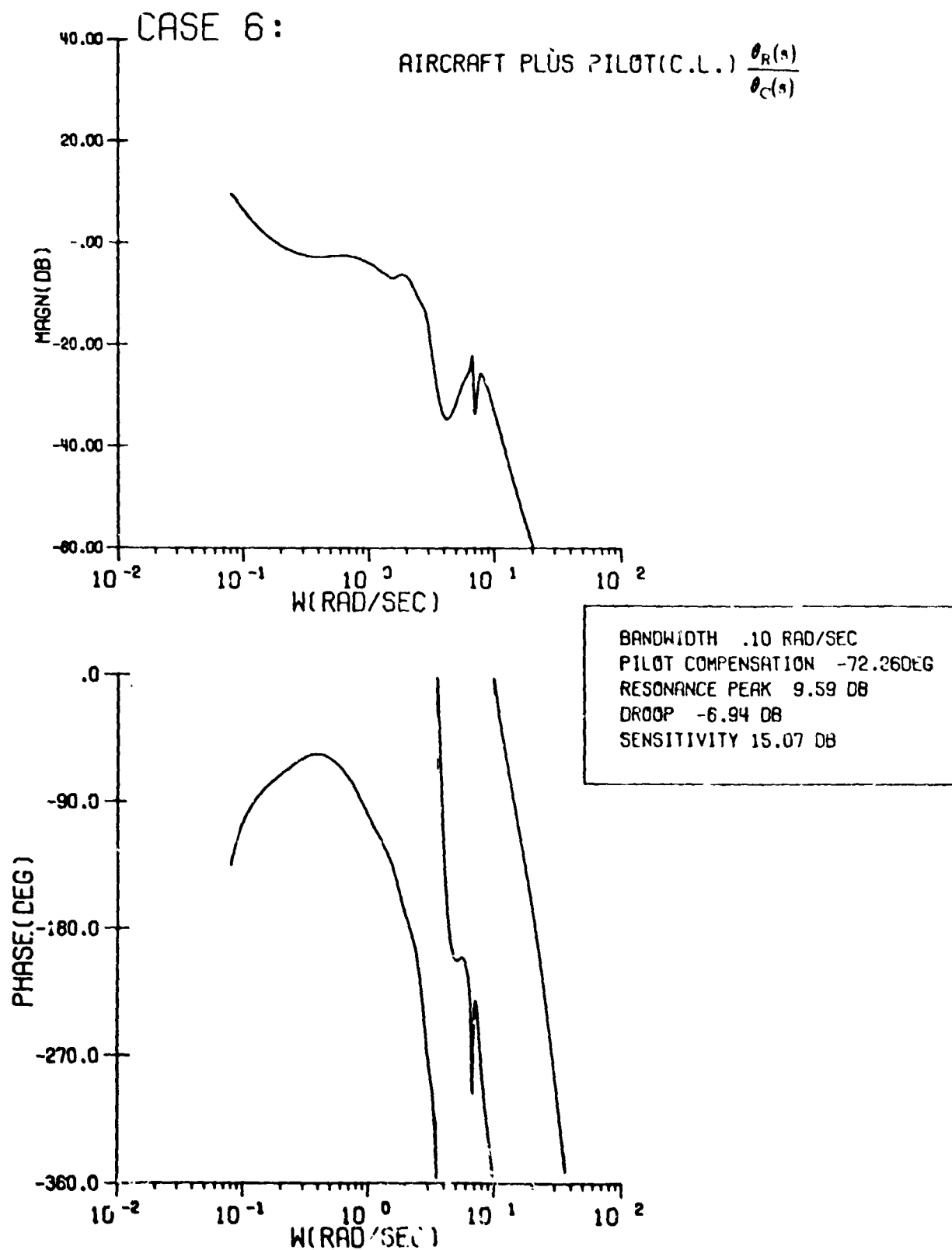


Figure A.5.6 (cont.)
OCM Frequency Responses - Config. 6

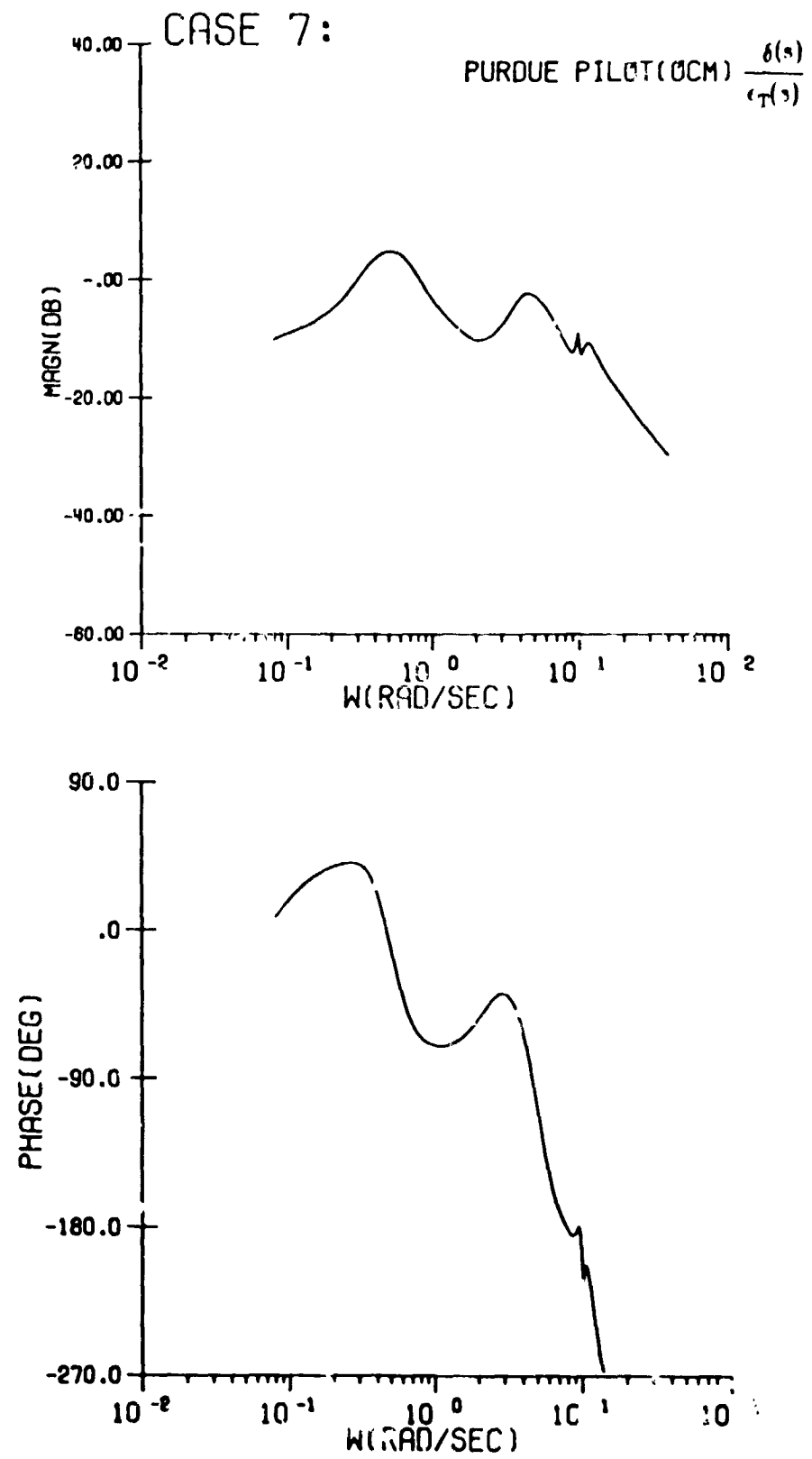


Figure A.5.7
OCM Frequency Responses - Config. 7

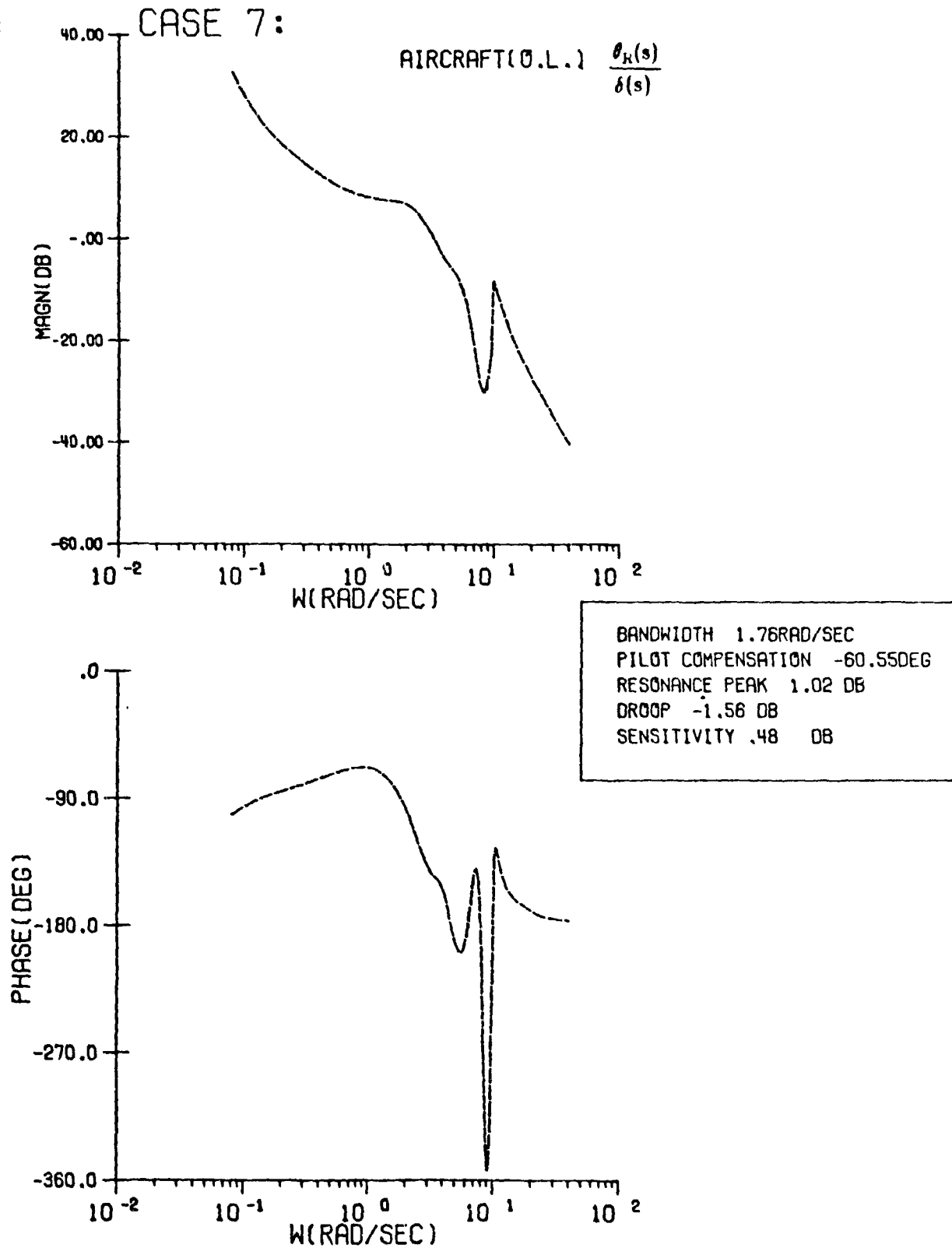


Figure A.5.7 (con't)
OCM Frequency Responses - Config. 7

C-3

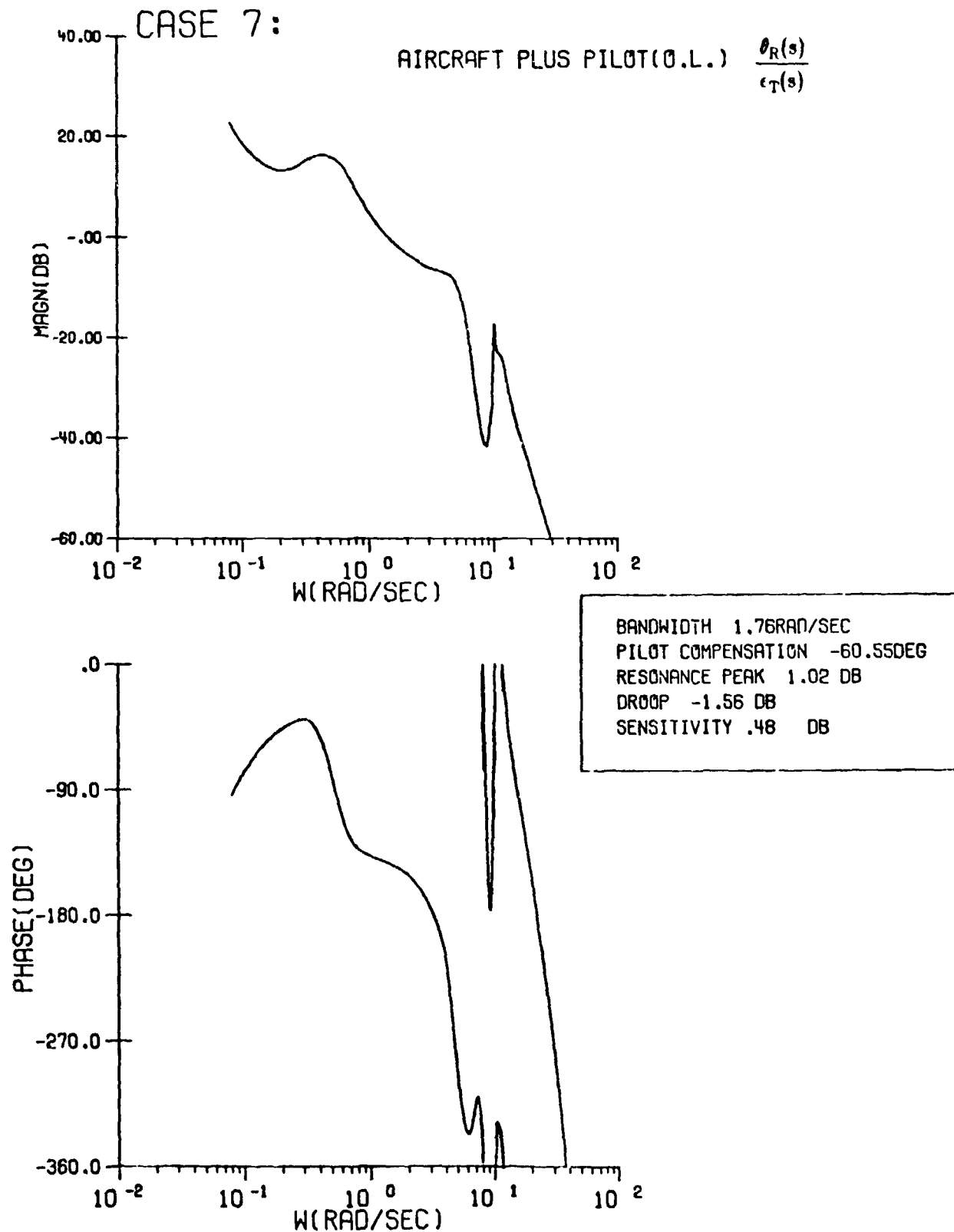


Figure A.5.7 (con't)
OCM Frequency Responses - Config. 7

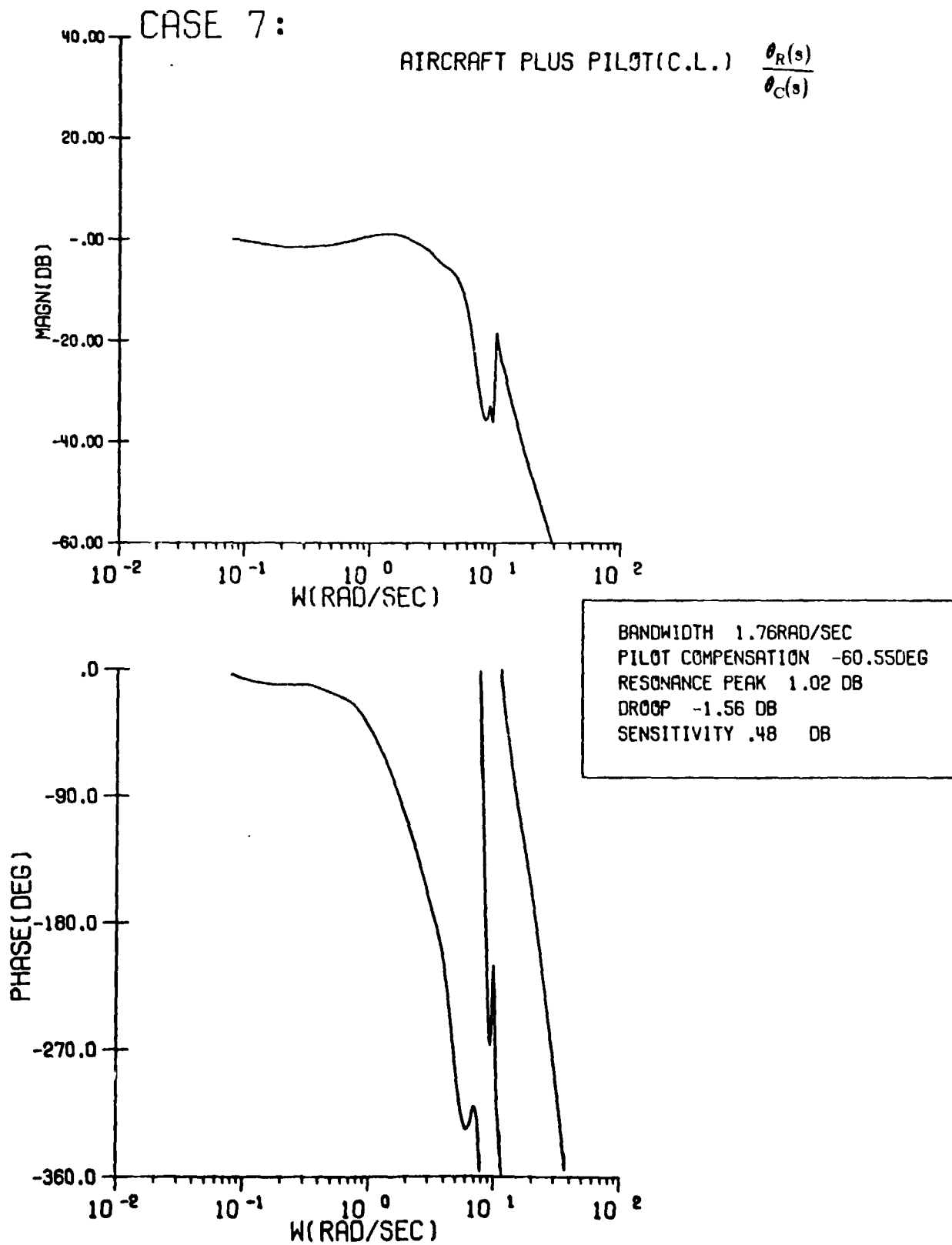


Figure A.5.7 (con't)
CCM Frequency Responses - Config. 7

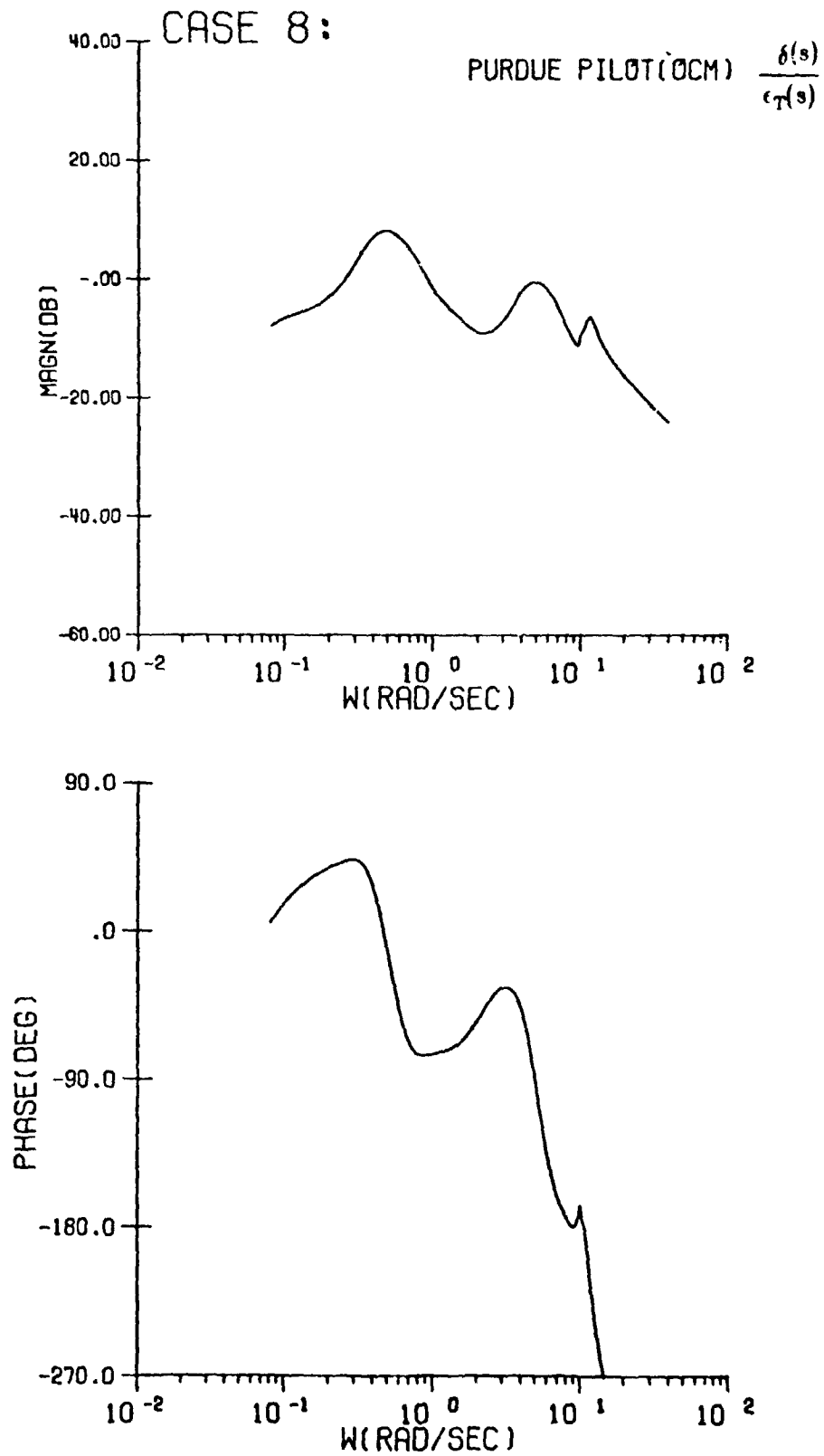


Figure A.5.8
OCM Frequency Responses - Config. 8

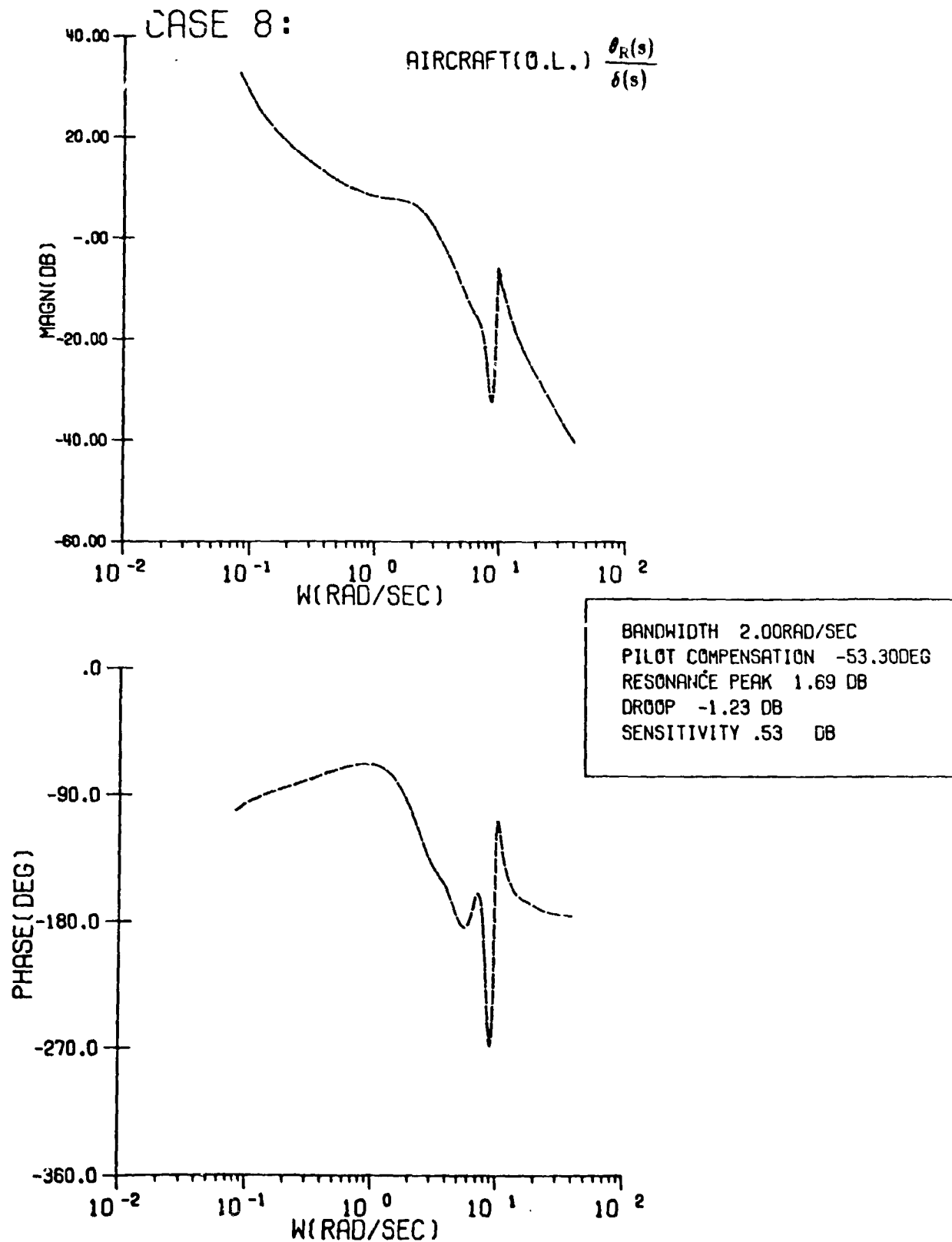


Figure A.5.8 (con't)
 OCM Frequency Responses - Config. 8

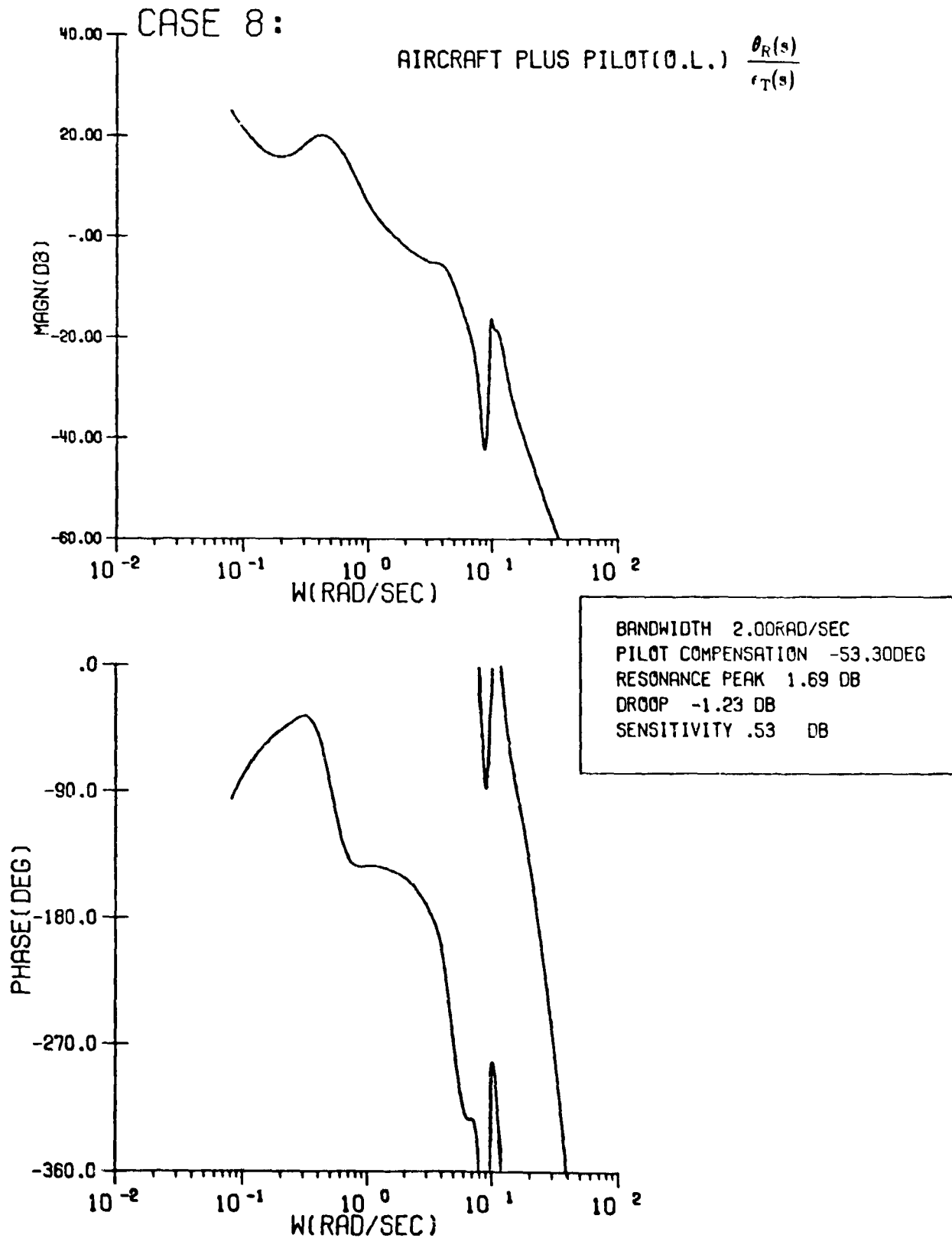


Figure A.5.8 (con't)
 OCM Frequency Responses - Config. 8

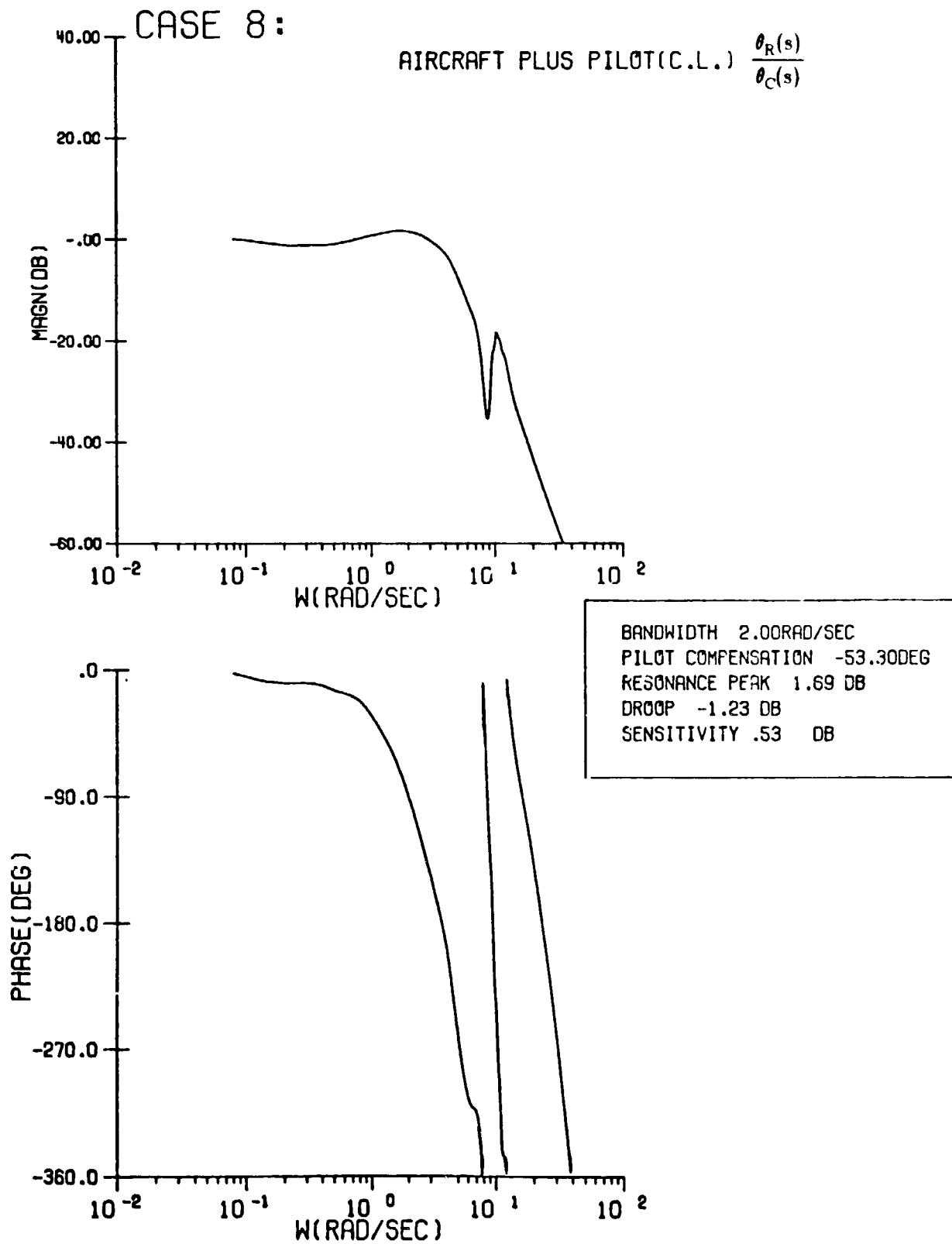


Figure A.5.8 (con't)
OCM Frequency Responses - Config. 8

Appendix A.6

Listing of Modal Analysis Program

The modal analysis computer program which was used for the open-loop analysis method is presented here. This program is written in FORTRAN and makes use of a modular structure to simplify its use and to allow the reader to more easily follow the procedure. Documentation is integrated with the code and a variable name listing and description is included to further aide the reader.

Even though the program was written to be flexible, it is based on a linear system analysis package of subroutines that is unique to the Purdue computer system. The package was developed at Purdue and is entitled LSLIB.

LIST OF VARIABLES USED IN MODAL ANALYSIS PROGRAM

VARIABLE NAME	VARIABLE TYPE	DESCRIPTION
A	↑ REAL	↑ UTILITY VARIABLE USED IN SUBROUTINE PHAG
AA	↑ REAL ARRAY	↑ AUGMENTED SYSTEM MATRIX
AG	↑ REAL ARRAY	↑ GUST EQUATION SYSTEM MATRIX
AMASE	↑ REAL ARRAY	↑ ARRAY USED IN FORMING MAG/PHASE FORM OF COMPLEX MATRICES
AP	↑ REAL ARRAY	↑ PILOT EQUATION SYSTEM MATRIX
ARRAY	↑ REAL ARRAY	↑ UTILITY ARRAY USED IN SUBROUTINE PHAG
AS	↑ REAL ARRAY	↑ UTILITY ARRAY USED IN SCALING MATRIX AU
AU	↑ REAL ARRAY	↑ VEHICLE EQUATION SYSTEM MATRIX
B	↑ REAL ARRAY	↑ VEHICLE EQUATION CONTROL MATRIX
B	↑ REAL	↑ UTILITY VARIABLE USED IN SUBROUTINE PHAG
BB	↑ REAL ARRAY	↑ AUGMENTED CONTROL MATRIX - USED ONLY IF THE PILOT CHARACTERISTICS ARE NOT BEING MODELED IN THE ANALYSIS
BS	↑ REAL ARRAY	↑ UTILITY ARRAY USED IN SCALING MATRIX B
C	↑ REAL ARRAY	↑ OUTPUT MATRIX ASSOCIATED WITH THE VEHICLE STATES
CASE	↑ REAL ARRAY	↑ ALPHA-NUMERIC USED TO TITLE OUTPUT
CC	↑ REAL ARRAY	↑ AUGMENTED OUTPUT MATRIX FORMED BY COMBINING C, E, AND F
CNM	↑ REAL ARRAY	↑ UTILITY VECTOR USED TO DETERMINE ELEMENTS OF C ASSOCIATED WITH PLUNGE ACCELERATION (NZ)
CON	↑ COMPLEX ARRAY	↑ CONTROLABILITY MATRIX FORMED FROM THE MODAL MATRIX (EE) AND THE SYSTEM CONTROL MATRIX (BB OR CP)
CS	↑ REAL ARRAY	↑ UTILITY ARRAY USED IN SCALING MATRIX C
D	↑ REAL ARRAY	↑ VEHICLE EQUATION DISTURBANCE MATRIX
DIST	↑ COMPLEX ARRAY	↑ DISTURBABILITY MATRIX FORMED FROM THE MODAL MATRIX (EE) AND THE SYSTEM DISTURBANCE MATRIX (GG)

DS	↑ REAL ARRAY	↑ UTILITY ARRAY USED IN SCALING MATRIX D
E	↑ REAL ARRAY	↑ OUTPUT MATRIX ASSOCIATED WITH THE CONTROLS
EE	↑ COMPLEX ARRAY	↑ MATRIX OF EIGENVECTORS OF MATRIX AA (ALSO CALLED THE MODAL MATRIX)
EI	↑ COMPLEX ARRAY	↑ INVERSE OF MATRIX EE (INVERSE MODAL MATRIX)
EIG	↑ COMPLEX ARRAY	↑ VECTOR OF EIGENVALUES OF MATRIX AA
EIGMAT	↑ COMPLEX ARRAY	↑ DIAGONAL MATRIX OF EIGENVALUES EIG
EINU	↑ COMPLEX ARRAY	↑ INVERSE OF MATRIX EIGMAT
ENM	↑ REAL ARRAY	↑ UTILITY VECTOR USED TO DETERMINE ELEMENTS OF E ASSOCIATED WITH PLUNGE ACCELERATION (NZ)
F	↑ REAL ARRAY	↑ OUTPUT MATRIX ASSOCIATED WITH THE DISTURBANCES
FIELD	↑ REAL	↑ USED IN PRINTING REAL MATRICES (ONLY USED IN MPRINT, A LSLIB ROUTINE)
FIELDG	↑ REAL	↑ USED IN PRINTING COMPLEX MATRICES (ONLY USED IN CMRNT, A LSLIB ROUTINE)
FMN	↑ REAL ARRAY	↑ UTILITY VECTOR USED TO DETERMINE ELEMENTS OF F ASSOCIATED WITH PLUNGE ACCELERATION (NZ)
FORMAA	↑ SUBROUTINE	↑ FORMS AUGMENTED SYSTEM MATRIX AA
FORMBB	↑ SUBROUTINE	↑ FORMS AUGMENTED CONTROL MATRIX BB WHEN NP=0
FORMCC	↑ SUBROUTINE	↑ FORMS AUGMENTED OUTPUT MATRIX CC
FORMGA	↑ SUBROUTINE	↑ FORMS AUGMENTED CONTROL MATRIX GPA AND AUGMENTED DISTURBANCE MATRIX GGA
FORMNZ	↑ SUBROUTINE	↑ FORMS PLUNGE ACCELERATION ELEMENTS OF THE OUTPUT MATRICES C, E AND F
GG	↑ REAL ARRAY	↑ DISTURBANCE EQUATION WHITE NOISE MATRIX
GGA	↑ REAL ARRAY	↑ AUGMENTED SYSTEM WHITE NOISE DISTURBANCE MATRIX
GP	↑ REAL ARRAY	↑ PILOT EQUATION WHITE NOISE MATRIX
GPA	↑ REAL ARRAY	↑ AUGMENTED SYSTEM WHITE NOISE CONTROL MATRIX
GRAV	↑ REAL	↑ GRAVITATIONAL ACCELERATION
HBLANK	↑ REAL	↑ USED IN PRINTING MATRICES (ONLY USED IN MPRINT AND CMRNT, LSLIB ROUTINES)
I	↑ INTEGER	↑ DO LOOP COUNTING VARIABLE
IMPMAI	↑ COMPLEX ARRAY	↑ UTILITY ARRAY FOR OUTPUTTING RESIDUES (IMPMAI = IMPULSE RESIDUE MATRIX)

IP	↑ INTEGER	↑ DO LOOP COUNTING VARIABLE
ITITLE	↑ INTEGER	↑ ALPHA-NUMERIC USED TO TITLE MATRICES
J	↑ INTEGER	↑ DO LOOP COUNTING VARIABLE
JP	↑ INTEGER	↑ DO LOOP COUNTING VARIABLE
JTITLE	↑ INTEGER	↑ ALPHA-NUMERIC USED TO TITLE MATRICES
K	↑ INTEGER	↑ DO LOOP COUNTING VARIABLE
KP	↑ INTEGER	↑ DO LOOP COUNTING VARIABLE
L	↑ INTEGER	↑ DO LOOP COUNTING VARIABLE
LINE	↑ INTEGER	↑ VARIABLE USED IN HEADER, A LSLIB ROUTINE ↑ USED TO TITLE OUTPUT
LX	↑ REAL	↑ DISTANCE FROM NOSE TO C.G. OF AIRCRAFT (FT)
M	↑ INTEGER	↑ # OF COLUMNS IN MATRIX ARRAY IN ↑ SUBROUTINE PHAG
MATOUT	↑ COMPLEX ARRAY	↑ UTILITY MATRIX FOR OUTPUTTING COMPLEX ↑ MATRICES IN MAG/PHASE FORM
MODAL	↑ SUBROUTINE	↑ DETERMINES MODAL MATRIX, INVERSE MODAL ↑ MATRIX AND EIGENVALUES OF A MATRIX
N	↑ INTEGER	↑ # OF COLUMNS IN MATRIX MATOUT IN ↑ SUBROUTINE PHAG
NACC	↑ INTEGER	↑ # OF AG COLUMNS
NAGR	↑ INTEGER	↑ # OF AG ROWS
NAMEAG	↑ INTEGER	↑ ALPHA-NUMERIC NAMING THE AG MATRIX
NAMEAP	↑ INTEGER	↑ ALPHA-NUMERIC NAMING THE AP MATRIX
NAMEAU	↑ INTEGER	↑ ALPHA-NUMERIC NAMING THE AU MATRIX
NAMEB	↑ INTEGER	↑ ALPHA-NUMERIC NAMING THE B MATRIX
NAMEC	↑ INTEGER	↑ ALPHA-NUMERIC NAMING THE C MATRIX
NAMED	↑ INTEGER	↑ ALPHA-NUMERIC NAMING THE D MATRIX
NAMEE	↑ INTEGER	↑ ALPHA-NUMERIC NAMING THE E MATRIX
NAMEF	↑ INTEGER	↑ ALPHA-NUMERIC NAMING THE F MATRIX
NAMEGG	↑ INTEGER	↑ ALPHA-NUMERIC NAMING THE GG MATRIX
NAMEGP	↑ INTEGER	↑ ALPHA-NUMERIC NAMING THE GP MATRIX
NAPC	↑ INTEGER	↑ # OF AP COLUMNS
NAPR	↑ INTEGER	↑ # OF AP ROWS

NAVC	↑ ↑ INTEGER	↑ ↑ # OF AV COLUMNS
NAUR	↑ ↑ INTEGER	↑ ↑ # OF AV ROWS
NBC	↑ ↑ INTEGER	↑ ↑ # OF B COLUMNS
NBR	↑ ↑ INTEGER	↑ ↑ # OF B ROWS
NC	↑ ↑ INTEGER	↑ ↑ # OF CONTROLS IN VEHICLE EQUATION
NCC	↑ ↑ INTEGER	↑ ↑ # OF C COLUMNS
NCDU	↑ ↑ INTEGER	↑ ↑ NC + ND + NU
NCP	↑ ↑ INTEGER	↑ ↑ USED IN PRINTING MATRICES (ONLY USED IN ↑ MPRINT AND CMRNT, LSLIB ROUTINES)
NCPC	↑ ↑ INTEGER	↑ ↑ USED IN PRINTING MATRICES (ONLY USED IN ↑ MPRINT AND CMRNT, LSLIB ROUTINES)
NCR	↑ ↑ INTEGER	↑ ↑ # OF C ROWS
ND	↑ ↑ INTEGER	↑ ↑ # OF DISTURBANCES IN VEHICLE EQUATION
NDC	↑ ↑ INTEGER	↑ ↑ # OF D COLUMNS
NDR	↑ ↑ INTEGER	↑ ↑ # OF D ROWS
NDU	↑ ↑ INTEGER	↑ ↑ ND + NU
NFE	↑ ↑ INTEGER	↑ ↑ # OF E COLUMNS
NER	↑ ↑ INTEGER	↑ ↑ # OF E ROWS
NFC	↑ ↑ INTEGER	↑ ↑ # OF F COLUMNS
NFR	↑ ↑ INTEGER	↑ ↑ # OF F ROWS
NGGC	↑ ↑ INTEGER	↑ ↑ # OF GG COLUMNS
NGGR	↑ ↑ INTEGER	↑ ↑ # OF GG ROWS
NGPC	↑ ↑ INTEGER	↑ ↑ # OF GP COLUMNS
NGPR	↑ ↑ INTEGER	↑ ↑ # OF GP ROWS
NH	↑ ↑ INTEGER	↑ ↑ # OF OUTPUTS IN OUTPUT EQUATION
NP	↑ ↑ INTEGER	↑ ↑ FLAG FOR USING PILOT EQUATION IN ↑ THE ANALYSIS (NP=0; NO PILOT - NP=NC; PILOT)
NPDU	↑ ↑ INTEGER	↑ ↑ NP + ND + NU
NRA	↑ ↑ INTEGER	↑ ↑ ROW DIMENSION OF MATRIX MATOUT IN ↑ SUBROUTINE PHAG
NRB	↑ ↑ INTEGER	↑ ↑ # OF RIGID BODY STATES IN VEHICLE EQUATION
NROW	↑ ↑ INTEGER	↑ ↑ ROW DIMENSION OF MATRIX ARRAY IN

	↑	↑ SUBROUTINE PHAG
	↑	↑
NS.	↑ INTEGER	↑ # OF STRUCTURAL MODE STATES MODELED IN
	↑	↑ THE VEHICLE EQUATION
	↑	↑
NU	↑ INTEGER	↑ # OF STATES IN THE VEHICLE EQUATION
	↑	↑
NW	↑ INTEGER	↑ ROW DIMENSION OF VEHICLE SYSTEM MATRICES
	↑	↑ (THIS IS THE LARGEST POSSIBLE MODEL WHICH
	↑	↑ CAN BE ANALYZED WITHOUT ALTERING THE PROGRAM)
	↑	↑
NWX	↑ INTEGER	↑ NW + NX
	↑	↑
NWXY	↑ INTEGER	↑ NW + NX + NY
	↑	↑
NWY	↑ INTEGER	↑ NW + NY
	↑	↑
NX	↑ INTEGER	↑ ROW DIMENSION OF PILOT SYSTEM MATRICES
	↑	↑ (THIS IS THE LARGEST PILOT MODEL WHICH
	↑	↑ THE PROGRAM CAN HANDLE WITHOUT ALTERATION)
	↑	↑
NY	↑ INTEGER	↑ ROW DIMENSION OF DISTURBANCE SYSTEM MATRICES
	↑	↑ (THIS IS THE LARGEST GUST MODEL WHICH THE
	↑	↑ PROGRAM CAN HANDLE WITHOUT ALTERATION)
	↑	↑
NZ	↑ INTEGER	↑ ROW DIMENSION OF THE OUTPUT MATRICES
	↑	↑ (THIS IS THE LARGEST POSSIBLE NUMBER OF
	↑	↑ OUTPUTS WHICH THE PROGRAM CAN HANDLE
	↑	↑ WITHOUT ALTERATION)
	↑	↑
OBS	↑ COMPLEX ARRAY	↑ OBSERVABILITY MATRIX FORMED FROM THE MODAL
	↑	↑ MATRIX (EE) AND THE OUTPUT MATRIX (CC)
	↑	↑
PHAG	↑ SUBROUTINE	↑ OUTPUTS A COMPLEX MATRIX IN PHASE AND
	↑	↑ MAGNITUDE FORM (PHASE IN DEGREES)
	↑	↑
PHI	↑ REAL ARRAY	↑ MODE SHAPES FOR EACH OF THE STRUCTURAL MODES
	↑	↑
PHIP	↑ REAL ARRAY	↑ MODES SLOPES FOR EACH OF THE STRUCTURAL MODES
	↑	↑
RESID	↑ SUBROUTINE	↑ DETERMINES THE IMPULSE RESIDUE MATRIX OF A
	↑	↑ SYSTEM GIVEN THE CONTROLLABILITY OR
	↑	↑ DISTURBABILITY AND OBSERVABILITY MATRICES
	↑	↑
SCALE	↑ SUBROUTINE	↑ SCALES THE MATRICES OF A SYSTEM (IE. DYNAMIC,
	↑	↑ CONTROL, DISTURBANCE AND OUTPUT MATRICES)
	↑	↑ WITH A DIAGONAL SCALING MATRIX
	↑	↑
STEP	↑ SUBROUTINE	↑ FORMS STEP RESIDUE MATRIX GIVEN IMPULSE
	↑	↑ RESIDUE MATRIX AND VECTOR OF EIGENVALUES
	↑	↑
STP	↑ COMPLEX ARRAY	↑ UTILITY ARRAY FOR FORMING RESIDUE MATRICES
	↑	↑ (USED IN SUBROUTINE STEP)
	↑	↑
STPMAT	↑ COMPLEX ARRAY	↑ UTILITY ARRAY FOR OUTPUTTING RESIDUES
	↑	↑ (STPMAT = STEP RESIDUE MATRIX)
	↑	↑
SUBT	↑ REAL ARRAY	↑ VARIABLE USED IN PRINTING THE HEADING ON
	↑	↑ THE OUTPUT
	↑	↑

T	↑ REAL ARRAY	↑ SCALING MATRIX FOR SCALING THE VEHICLE STATES
	↑	↑
TERM1	↑ REAL	↑ INTERMEDIATE VARIABLE IN SUBROUTINE PHAG
	↑	↑
TERM2	↑ REAL	↑ INTERMEDIATE VARIABLE IN SUBROUTINE PHAG
	↑	↑
TINU	↑ REAL ARRAY	↑ INVERSE OF MATRIX T
	↑	↑
TITLE	↑ REAL ARRAY	↑ VARIABLE USED FOR PRINTING THE HEADING ON
	↑	↑ THE OUTPUT
	↑	↑
UZERO	↑ REAL	↑ CRUISE VELOCITY OF AIRCRAFT
	↑	↑
WORK	↑ SUBROUTINE	↑ DETERMINES THE CONTROLABILITY, DISTURBABILITY
	↑	↑ AND OBSERVABILITY MATRICES OF A SYSTEM GIVEN
	↑	↑ THE SYSTEM MATRICES AND THE MODAL MATRIX
	↑	↑
WK	↑ REAL ARRAY	↑ UTILITY VECTOR USED IN SEVERAL SUBROUTINES
	↑	↑
X	↑ REAL ARRAY	↑ TRANSFORMATION VECTOR USED IN DETERMINING
	↑	↑ ELEMENTS OF THE C MATRIX ASSOCIATED WITH
	↑	↑ THE PLUNGE ACCELERATION (NZ)


```

C
C ///////////////////////////////////////////////////////////////////
C
C ANALYSIS OF FLEXIBLE AIRCRAFT DYNAMICS USING MODAL ANALYSIS METHODS
C =====
C
C THIS PROGRAM USES A MODAL ANALYSIS TECHNIQUE TO DETERMINE THE
C IMPULSE RESIDUES OF A STATE VARIABLE MATH MODEL OF A FLEXIBLE
C AIRCRAFT. IT DOES THIS ANALYSIS BY FORMING AN AUGMENTED SYSTEM
C FROM THE MATRIX EQUATIONS DESCRIBING THE VEHICLE DYNAMICS AND
C THE FREQUENCY CHARACTERISTICS OF A HUMAN PILOT AND ATMOSPHERIC
C DISTURBANCES.
C
C -----
C
C VEHICLE MATRIX EQUATION -
C
C      X-DOT = [AU]*X + [B]*U + [D]*W
C
C      Y = [C]*X + [E]*U + [F]*W
C
C
C PILOT MATRIX EQUATION -
C
C      U-DOT = [AP]*U + [GP]*ETA
C
C
C DISTURBANCE MATRIX EQUATION -
C
C      W-DOT = [AG]*W + [GG]*ETA
C
C -----
C
C PROGRAM ANAFLEX(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,
C * TAPE1,TAPE2,TAPE3)
C
C -----
C :::::  DIMENSION STATEMENTS  :::::
C -----
C
C      DIMENSION AU(20,20),    B(20,5),    D(20,5)
C      DIMENSION C(15,20),    E(15,5),    F(15,5)
C
C      DIMENSION AP(5,5),      GP(5,5)
C
C      DIMENSION AG(5,5),      GG(5,5)
C
C      DIMENSION AA(30,30),    BB(25,5),    CC(15,30)
C      DIMENSION GPA(30,5),    GGA(30,5)
C
C      COMPLEX EIG(30),        EE(30,30),    EI(30,30)
C      COMPLEX CON(30,5),      OBS(15,30),    DIST(30,5)
C
C      COMPLEX IMPMAT(30,15),  STPMAT(30,15)
C
C      DIMENSION T(20,20),    TINV(20,20)

```

```

C      DIMENSION TITLE(7),      CASE(4),      SUBT(2)
C      DIMENSION PHI(4),        PHIP(4)
C      DIMENSION X(1,20),        CNM(1,20),      ENM(1,5), FNM(1,5)
C
C      DIMENSION AS(20,20),      BS(20,5),      CS(15,20), DS(20,5)
C
C      DIMENSION AMASE(30,2),     ITITLE(2),     JTITLE(2)
C      DIMENSION ICNAME(2),       IDNAME(2),     IONAME(2)
C
C      COMPLEX MATOUT(30,30)
C      COMPLEX EIGMAT(30,30),     EINV(30,30)
C
C      DIMENSION AR(20,20),      ART(20,20),     ATR(20,20), AT(20,20)
C      DIMENSION BR(20,5),      BT(20,5),      DR(20,5),   DT(20,5)
C      DIMENSION CR(15,20),     CT(15,20)
C
C      LOGICAL TEST(20)
C
C      DIMENSION A3(20,20),      B3(20,5),      D3(20,5)
C      DIMENSION C3(15,20),     E3(15,5),      F3(15,5)
C
C      DIMENSION ATI(20,20)
C
C      DIMENSION (20,20),      BM(20,5),      DM(20,5)*
C      DIMENSION C(15,20),     EM(15,5),      FM(15,5)
C
C      REAL LX
C
C      EXTERNAL PHAG
C
C-----
C::::: COMMON BLOCKS ::::::
C-----
C*** THESE VARIABLES ARE USED IN PRINTING THE HEADINGS ON THE OUTPUT
C
COMMON/MPRINT/ NCP, FIELD, NCPC, FIELDG, HBLANK
COMMON/HEAD/ TITLE, CASE, LINE
C
C*** THESE VARIABLES ARE THE ACTUAL WORKING MATRIX DIMENSIONS
C*** USED IN MOST OF THE SUBROUTINES
C
COMMON/DIM/ NU, NC, ND, NM, NP
C
C-----
C::::: SET ROW DIMENSIONS ::::::
C-----
C*** THESE VARIABLES ARE THE ROW DIMENSIONS OF THE SYSTEM MATRICES
C
C      ROW DIMENSION = SIZE OF MATRIX SET IN DIMENSION STATEMENTS
C
C*** THESE ROW DIMENSIONS MUST BE AT LEAST AS LARGE
C*** AS THE WORKING DIMENSIONS
C
C      AU(NW,NW),      B(NW,NX),      D(NW,NY)
C      AP(NX,NX),      GP(NX,NX)
C      AG(NY,NY),      CG(NY,NY)
C      C(NZ,NX),      E(NZ,NX),      F(NZ,NY)
C      AA(NWXY,NWXY),  DD(NWXY,NX),    CC(NZ,NWXY)
C      GPA(NWXY,NX),  GCA(NWXY,NY)

```

```

C
  NW = 20
  NX = 5
  NY = 5
  NZ = 15
  NWY = NW + NY
  NWXY = NW + NX + NY
C
C=====
C
C      PHYSICAL PARAMETERS PARTICULAR TO THIS PROBLEM      ↑
C////////////////////////////////////////////////////↑
C=====
C      NUMBER OF STRUCTURAL MODES MODELED
C      NSM = 4
C=====
C      STRUCTURAL MODE   ::: SHAPES (FT)   ::: SLOPES      ↑
C=====
C                                PHI(1) = .349 $   PHIP(1) = -.02640
C                                PHI(2) = .400 $   PHIP(2) = -.03300
C                                PHI(3) = .180 $   PHIP(3) = -.03456
C                                PHI(4) = .140 $   PHIP(4) = -.03636
C=====
C      CRUISE VELOCITY (FT/SEC)                                ↑
C      UZERO = 949.0
C=====
C      COCKPIT LOCATION (FT)                                  ↑
C      LX = 63.4
C=====
C      GRAVITATIONAL ACCELERATION (FT/SEC/SEC)               ↑
C      GRAU = 32.17
C
C////////////////////////////////////////////////////
C-----
C-----
C::: READ TITLES :::
C-----
C***  TITLE / CASE / SUBTITLE
C
  READ(5,501) TITLE
  WRITE(3,501) TITLE
501  FORMAT(7A10)
  READ(5,502) CASE
  WRITE(3,502) CASE
502  FORMAT(4A10)
  READ(5,503) SUBT
  WRITE(3,503) SUBT
503  FORMAT(2A10)
C
C***  THIS SUBROUTINE PRINTS THE HEADER ON THE OUTPUT
C
  CALL HEADER(SUBT)
C
C-----
C::: READ MATRICES :::
C-----
C***  NAME / DIMENSION (ROW,COLUMN) / ELEMENTS
C
  READ(5,504) NAMEAU

```

```

WRITE(3,504) NAMEAU
READ(5,*) NAUR,NAUC
WRITE(3,*) NAUR,NAUC
DO 1 I=1,NAUR
  READ(5,*) (AU(I,J),J=1,NAUC)
1 WRITE(3,*) (AU(I,J),J=1,NAUC)
  READ(5,504) NAMEAG
  READ(5,*) NAGR,NAGC
  DO 2 I=1,NAGR
2  READ(5,*) (AG(I,J),J=1,NAGC)
    READ(5,504) NAMEB
    WRITE(3,504) NAMEB
    READ(5,*) NBR,NBC
    WRITE(3,*) NBR,NBC
    DO 3 I=1,NBR
    READ(5,*) (B(I,J),J=1,NBC)
3  WRITE(3,*) (B(I,J),J=1,NBC)
    READ(5,504) NAMEC
    WRITE(3,504) NAMEC
    READ(5,*) NCR,NCC
    WRITE(3,*) NCR,NCC
    DO 4 I=1,NCR
    READ(5,*) (C(I,J),J=1,NCC)
4  WRITE(3,*) (C(I,J),J=1,NCC)
    READ(5,504) NAMED
    WRITE(3,504) NAMED
    READ(5,*) NDR,NDC
    WRITE(3,*) NDR,NDC
    DO 5 I=1,NDR
    READ(5,*) (D(I,J),J=1,NDC)
5  WRITE(3,*) (D(I,J),J=1,NDC)
    READ(5,504) NAMEE
    WRITE(3,504) NAMEE
    READ(5,*) NER,NEC
    WRITE(3,*) NER,NEC
    DO 6 I=1,NER
    READ(5,*) (E(I,J),J=1,NEC)
6  WRITE(3,*) (E(I,J),J=1,NEC)
    READ(5,504) NAMEF
    WRITE(3,504) NAMEF
    READ(5,*) NFR,NFC
    WRITE(3,*) NFR,NFC
    DO 7 I=1,NFR
    READ(5,*) (F(I,J),J=1,NFC)
7  WRITE(3,*) (F(I,J),J=1,NFC)
    READ(5,504) NAMEGG
504  FORMAT(A4)
    READ(5,*) NGGR,NGGC
    DO 8 I=1,NGGR
8  READ(5,*) (GG(I,J),J=1,NGGC)
C
    READ(5,504) NAMEAP
    READ(5,*) NAPR,NAPC
    IF(NAPR.EQ.0) GO TO 10
C
    DO 11 I=1,NAPR
11  READ(5,*) (AP(I,J),J=1,NAPC)
    READ(5,504) NAMEGP
    READ(5,*) NGPR,NGPC
    DO 12 I=1,NGPR

```

```

12 READ(5,*) (GP(I,J),J=1,NGPC)
C-----
C::::: SET WORKING DIMENSIONS :::::
C-----
C*** THESE VARIABLES ARE THE ACTUAL DIMENSION OF THE SYSTEM MATRICES
C      AU(NU,NU),          B(NU,NC),          D(NU,ND)
C      C(NM,NU),           E(NM,NC),           F(NM,ND)
C      AP(NC,NC),          GP(NC,NC)
C      AG(ND,ND),          GG(ND,1)
C      AA(NCDU,NCDU),       BB(NDU,NC),        CC(NM,NCDU)
C
10 NU = NAUC
   NC = NBC
   ND = NDC
   NM = NCR
   NDU = NU + ND
   NCDU = NU + ND + NC
C-----
C*** INCLUDE PILOT MODEL IN ANALYSIS - NP = NC ↑
C*** IGNORE PILOT IN ANALYSIS - NP = 0 ↑
C-----
NP = NC
NPDV = NU + ND + NP
C=====
C THIS SECTION OF THE PROGRAM IS PROBLEM DEPENDENT ↑
C ////////////////////////////////////////////////////////////////////↑
C IT IS DUE TO THE CHOICE OF USING PLUNGE ↑
C ACCELERATION AS A SYSTEM OUTPUT VARIABLE ↑
C-----
C-----
C::::: FORM VECTOR-X FOR HZ EQUATION :::::
C-----
DO 13 I=1,NU
13 X(1,I) = 0.0
C
X(1,1) = -UZERO/GRAU
X(1,2) = LX/GRAU
X(1,4) = UZERO/GRAU
X(1,9) = -PHI(1)/GRAU
X(1,10) = -PHI(2)/GRAU
X(1,11) = -PHI(3)/GRAU
X(1,12) = -PHI(4)/GRAU
C-----
C::::: COMPLETE C MATRIX WITH NZ EQUATION :::::
C-----
CALL FORMNZ(AU,B,C,D,E,F,NW,NX,NY,NZ,X,CNM,ENM,FNM)
C=====

```

```

C
C-----
C::::: OUTPUT SYSTEM MATRICES :::::
C-----
C
  CALL MPRINT(NW,AU,NU,NU,6,6,NAMEAU,1)
  CALL MPRINT(NY,AG,ND,ND,ND,6,NAMEAG,1)
  CALL MPRINT(NW,B,NU,NC,NC,6,NAMEB,1)
  CALL MPRINT(NZ,C,NM,NU,6,6,NAMEC,1)
  CALL MPRINT(NW,D,NU,ND,ND,6,NAMED,1)
  CALL MPRINT(NZ,E,NM,NC,NC,6,NAMEE,1)
  CALL MPRINT(NZ,F,NM,ND,ND,6,NAMEF,1)
  IF (NP.EQ.0) GO TO 14
  CALL MPRINT(NX,AP,NC,NC,NC,6,NAMEAP,1)
14  CONTINUE
C
C-----
C::::: FORM SCALING MATRIX :::::
C-----
C
C-----
C      THE T MATRIX IS PROBLEM DEPENDENT
C/////
C***  THE ACTUAL SCALING MATRIX, T, IS PROBLEM DEPENDENT
C***  BUT THE SCALING PROCESS IS ALWAYS RECOMMENDED
C
C***  NUMBER OF RIGID BODY STATES
C
  NRB = NU - 2.0 * NSM
C
C-----
C***  IN THIS CASE, THE SCALING MATRIX, T, IS BASED ON MODE SLOPES
C
C      [ 1.0      ]
C      [ 1.0      ]
C      [ 1/U      ]
C      [ 1.0      ]
C      [ Y/X(1)    ]
C      [ Y/X(2)    ]
C      [ Y/X(3)    ]
C      [ Y/X(4)    ]
C      [ Y/X(1)    ]
C      [ Y/X(2)    ]
C      [ Y/X(3)    ]
C      [ Y/X(4)    ]
C
  T = DIAG(
C
C      - WHERE Y/X(I) IS THE MODE SLOPE ASSOCIATED WITH
C      THE ITH MODE OF THE STRUCTURE
C
C      -AND-
C
C      - WHERE U IS SOME CHARACTERISTIC VELOCITY
C      ( IN THIS CASE U = UZERO )
C
C-----
C
  DO 15 I=1,NU
  DO 16 J=1,NU
16  T(I,J) = 0.0

```

```

15  T(I,I) = 1.0
C
      T(3,3) = 1.0 / UZERO
C
      DO 17 I=1,NSM
        T(I+NRB,I+NRB) = PHIP(I)
17  T(I+NRB+NSM,I+NRB+NSM) = PHIP(I)
C
C ///////////////////////////////////////////////////////////////////
C-----
C-----
C::::: SCALE VEHICLE SYSTEM STATES :::::
C-----
C
      CALL SCALE(AU,B,C,D,NW,NX,NY,NZ,T,TINV,AS,BS,CS,DS)
C
C-----
C::::: OUTPUT SCALED MATRICES :::::
C-----
C
      CALL MPRINT(NW,T,NU,NU,6,6,*,SCALING*,1)
C
      CALL MPRINT(NW,AU,NU,NU,6,6,*,AU-SCALED*,1)
      CALL MPRINT(NW,B,NU,NC,NC,6,6,*,B-SCALED*,1)
      CALL MPRINT(NW,C,NM,NU,6,6,*,C-SCALED*,1)
      CALL MPRINT(NW,D,NU,ND,6,6,*,D-SCALED*,1)
C
C-----
C::::: SET UP TEST ARRAY :::::
C-----
C
C*** NR = THE NUMBER OF RETAINED STATES
C*** NT = THE NUMBER OF TRUNCATED STATES
C
      NR = 12
      NT = NU - NR
C
C*** INITIALIZE THE TEST ARRAY TO .TRUE.
C
      DO 29 I=1,NU
29  TEST(I) = .TRUE.
C
      IF (NT.EQ.0) GO TO 42
C
C*** IF TEST(I) = .FALSE. THE ITH STATE IS
C***          TRUNCATED IN THE RESIDUALIZATION
C
      TEST(6) = .FALSE.
      TEST(7) = .FALSE.
      TEST(8) = .FALSE.
      TEST(10) = .FALSE.
      TEST(11) = .FALSE.
      TEST(12) = .FALSE.
C
C-----
C::::: APPLY STATE MODEL RESIDUALIZATION :::::
C-----
C
      CALL SORT(AU,B,C,D,AR,ART,ATR,AR,BR,BT,DR,DT,CR,CT,TEST,
        NW,NX,NY,NZ,NR,NT)

```

ORIGINAL PAGE IS
OF POOR QUALITY

```

C
C///// OUTPUT PARTITIONED MATRICES
CALL MPRINT(NW,AR,NR,NR,NR,6,AR,+,1)
CALL MPRINT(NW,ART,NR,NT,NT,6,ART,+,1)
CALL MPRINT(NW,ATR,NT,NR,NR,6,ATR,+,1)
CALL MPRINT(NW,AT,NT,NT,NT,6,AT,+,1)
CALL MPRINT(NW,BR,NR,NC,NC,6,BR,+,1)
CALL MPRINT(NW,BT,NT,NC,NC,6,BT,+,1)
CALL MPRINT(NW,DR,NR,ND,ND,6,DR,+,1)
CALL MPRINT(NW,DT,NT,ND,ND,6,DT,+,1)
CALL MPRINT(NZ,CR,NM,NR,NR,6,CR,+,1)
CALL MPRINT(NZ,CT,NM,NT,NT,6,CT,+,1)

C
CALL MRR(AR,ART,ATR,AT,BR,BT,DR,DT,CR,CT,E,F,AM,BM,CM,DM,EM,FM,
NW,NX,NY,NZ,NR,NT,A3,B3,C3,D3,E3,F3,ATI)

C
GO TO 41

C
C*** IF NO TRUNCATION SET THE VEHICLE MATRICES TO THE MODIFIED MATRICES
C
42 CALL MEQ(AU,AM,NU,NU,NW,NW)
CALL MEQ(B,BM,NU,NC,NW,NW)
CALL MEQ(C,CM,NM,NU,NZ,NZ)
CALL MEQ(D,DM,NU,ND,NW,NW)
CALL MEQ(E,EM,NM,NC,NZ,NZ)
CALL MEQ(F,FM,NM,ND,NZ,NZ)

C
41 CONTINUE

C
C*** RESET NU SO THAT THE VEHICLE MODEL IS
C*** REPRESENTED BY THE SMALLER, RESIDUALIZED MODEL
C
NU = NR
NDU = ND + NU
NPDV = NP + ND + NU

C
C-----
C::::: FORM AUGMENTED WHITE NOISE MATRICES :::::
C-----
C      [ 0 ]      [ GP ]
C      GGA = [ GG ]      GPA = [ 0 ]
C      [ 0 ]      [ 0 ]
C
C      IF NP = 0 ;
C
C      GGA = [ GG ]      GPA = [ 0 ]
C      [ 0 ]
C-----
C
CALL FORMGA(GG,GP,NWXY,NX,NY,GGA,GPA)

C
C-----
C::::: OUTPUT NOISE MATRICES :::::
C-----
C
CALL MPRINT(NWY,GGA,NPDV,1,1,6,NAMEGG,1)
IF (NP.EQ.0) GO TO 39
CALL MPRINT(NWXY,GPA,NPDV,NC,NC,6,NAMEGP,1)
39 CONTINUE

```



```

C
C-----
C::: FORM AUGMENTED SYSTEM MATRIX :::
C-----
C
C      [ AP ↑ 0 ↑ 0 ]
C      AA = [ 0 ↑ AG ↑ 0 ]
C      [ B ↑ D ↑ AU ]
C
C      IF NP = 0 ;
C
C      AA = [ AG ↑ 0 ]
C      [ D ↑ AU ]
C-----
C
C      CALL FORMAA(CM,AG,AP,BM,DM,AA,NW,NX,NY,NWXY)
C
C      OUTPUT MATRIX AA ~~~~~
C      CALL MPRINT(NWXY,AA,NPDU,NPDU,8,6,AA,1)
C
C      IF (NP.NE.0) GO TO 18
C-----
C::: FORM AUGMENTED B MATRIX :::
C-----
C
C      ONLY IF NP = 0 ;
C
C      BB = [ 0 ]
C      [ B ]
C-----
C
C      CALL FORMBB(BM,BB,NW,NX,NWY)
C
C      OUTPUT MATRIX BB ~~~~~
C      CALL MPRINT(NW,BB,NDU,NC,6,6,BB,1)
C-----
C::: FORM AUGMENTED C MATRIX :::
C-----
C
C      CC = [ E ↑ F ↑ C ]
C
C      IF NP = 0 ;
C
C      CC = [ F ↑ C ]
C-----
C
C 18 CALL FORMCC(CM,EM,FM,CC,NW,NX,NY,NZ,NWXY)
C
C      OUTPUT MATRIX CC ~~~~~
C      CALL MPRINT(NZ,CC,NM,NPDU,5,6,CC,1)
C-----
C::: DETERMINE E-VALUES AND E-VECTORS OF MATRIX AA :::
C-----
C*** THIS SUBROUTINE USES GEIGEN WHICH OUTPUTS THE E-VALUES

```

```

C
C      CALL MODAL(AA,EIG,EE,EI,NWXY)
C
C////////// OUTPUT E-VECTOR MATRIX ~~~~~
C      CALL CMPRNT(NWXY,EE,NPDU,NPDU,6,6,EE,1)
C
C-----
C::::: DETERMINE CONTROLABILITY, DISTURBABILITY AND :::::
C::::: OBSERVABILITY MATRICES :::::
C-----
C
C      CON = MINU * B
C      DIST = MINU * D
C      OBS = C * M
C              -WHERE M = MODAL MATRIX
C-----
C
C      IF (NP.EQ.0) GO TO 21
C
C      CALL WORK(GPA,CC,GGA,EE,EI,NX,NY,NZ,NWXY,CON,OBS,DIST)
C      GO TO 22
C
C21  CALL WORK(BB,CC,GGA,EE,EI,NX,NY,NZ,NWXY,CON,OBS,DIST)
C
C22  CONTINUE
C
C////////// OUTPUT CON, DIST, OBS MATRICES ~~~~~
C
C      DATA INAME// CONTROL//ABILITY //
C      DATA IDNAME// DISTURB//ABILITY //
C      DATA IONAME// OBSERVA//ABILITY //
C      CALL CMPRNT(NWXY,CON,NPDU,NC,6,6,CON,1)
C      CALL PHAG(CON,NWXY,NPDU,NC,IONAME,AMASE,MATOUT,NWXY)
C      CALL CMPRNT(NWXY,DIST,NPDU,1,6,6,DIST,1)
C      CALL PHAG(DIST,NWXY,NPDU,1,IDNAME,AMASE,MATOUT,NWXY)
C      CALL CMPRNT(NZ,OBS,NM,NPDU,6,6,OBS,1)
C      CALL PHAG(OBS,NZ,NM,NPDU,IONAME,AMASE,MATOUT,NZ)
C
C-----
C::::: DETERMINE MODAL IMPULSE AND STEP RESIDUE MATRICES :::::
C-----
C
C      RESMAT = OBS > < CON (OR DIST)
C-----
C
C      WRITE(S,601)
C001  FORMAT(///,10X,~~~~~//,
C      ^      10X,*** RESIDUE MATRICES ***//,
C      ^      10X,~~~~~//,
C      ^      10X,*** ROWS CORRESPOND TO MODES ***//,
C      ^      10X,*** COLUMNS CORRESPOND TO OUTPUTS ***//,
C      ^      10X,~~~~~//)
C
C*** I = # OF WHITE NOISE CONTROL INPUTS
C
C      DO 19 I=1,NC
C
C      CALL RESID(CON,OBS,NZ,NX,NWXY,IMPMAT,1)

```

```

C
C///// OUTPUT IMPULSE RESIDUE MATRIX -----
C
      WRITE(6,602) I
602  FORMAT(/,5X,-----,/,
      ^      5X, IMPULSE RESIDUE MATRIX FOR CONTROL - #.13,/,
      ^      5X,-----,/)
C
      CALL CMFRT(NWXY,IMPMAT,NPDU,NM,6,6,#C-IMP RES #.1)
C
      DATA ITITLE/# CONTROL# RESIDUE #/
      CALL PHAG(IMPMAT,NWXY,NPDU,NM,ITITLE,AMASE,MATOUT,NWXY)
C
      CALL STEP(IMPMAT,EIG,NWXY,NZ,STPMAT,EIGMAT,EINU)
C
C///// OUTPUT STEP RESIDUE MATRIX -----
C
      WRITE(6,604) I
604  FORMAT(//,5X,-----,/,
      ^      5X, STEP RESIDUE MATRIX FOR CONTROL - #.13,/,
      ^      5X,-----,/)
C
      CALL CMFRT(NWXY,STPMAT,NPDU,NM,6,6,#C-STP RES #.1)
C
      CALL PHAG(STPMAT,NWXY,NPDU,NM,ITITLE,AMASE,MATOUT,NWXY)
C
19  CONTINUE
C
C*** I = # OF WHITE NOISE DISTURBANCES
C
      I = 1
C
      CALL RESID(DIST,OBS,NZ,NY,NWXY,IMPMAT,I)
C
C///// OUTPUT IMPULSE RESIDUE MATRIX -----
C
      WRITE(6,603) I
603  FORMAT(//,5X,-----,/,
      ^      //,5X, IMPULSE RESIDUE MATRIX FOR DISTURBANCE - #.13,/,
      ^      5X,-----,/)
C
      CALL CMFRT(NWXY,IMPMAT,NPDU,NM,6,6,#D-IMP RES #.1)
C
      DATA JTITLE/# DISTURBANCE# RESIDUE #/
      CALL PHAG(IMPMAT,NWXY,NPDU,NM,JTITLE,AMASE,MATOUT,NWXY)
C
      CALL STEP(IMPMAT,EIG,NWXY,NZ,STPMAT,EIGMAT,EINU)
C
C///// OUTPUT STEP RESIDUE MATRIX -----
C
      WRITE(6,605) I
605  FORMAT(//,5X,-----,/,
      ^      5X, STEP RESIDUE MATRIX FOR DISTURBANCE - #.13,/,
      ^      5X,-----,/)
C
      CALL CMFRT(NWXY,STPMAT,NPDU,NM,6,6,#D-STP RES #.1)
C
      CALL PHAG(STPMAT,NWXY,NPDU,NM,JTITLE,AMASE,MATOUT,NWXY)
C
      REWIND 1

```

302

C

STOP
END

```

C::::::::::::::::::::::::::::::::::::::::::::::::::::
C      SUBROUTINE FORMAA
C::::::::::::::::::::::::::::::::::::::::::::::::::::
C      THIS SUBROUTINE FORMS THE AUGMENTED MATRIX -
C
C      [ AP ↑ 0 ↑ 0 ]
C      AA = [ 0 ↑ AG ↑ 0 ]
C      [ B ↑ D ↑ AU ]
C
C      - FROM THE MATRICES AP, AG, AU, B AND D
C      IF NP = NC
C
C      AND THE AUGMENTED MATRIX -
C
C      AA = [ AG ↑ 0 ]
C      [ D ↑ AU ]
C
C      - FROM THE MATRICES AG, AU AND D IF NP = 0
C
C-----
C      CALL STATEMENT ARGUMENTS -
C
C      AU : NU X NU MATRIX OF ROW DIMENSION NW
C      AG : ND X ND MATRIX OF ROW DIMENSION NY
C      AP : NC X NC MATRIX OF ROW DIMENSION NX
C      B : NU X NC MATRIX OF ROW DIMENSION NW
C      D : NU X ND MATRIX OF ROW DIMENSION NW
C      AA : NCDU X NCDU MATRIX OF ROW DIMENSION NWXY
C
C-----
C      SUBROUTINE FORMAA(AU,AG,AP,B,D,AA,NW,NX,NY,NWXY)
C      DIMENSION AU(NW,NW), AG(NY,NY), AP(NX,NX)
C      DIMENSION B(NW,NX), D(NW,NY), AA(NWXY,NWXY)
C
C      COMMON /DIM/ NU, NC, ND, NM, NP
C
C      NPDU = NU + ND + NP
C
C      INITIALIZE MATRIX AA TO ZERO
C
C      DO 10 I=1,NPDU
C      DO 20 J=1,NPDU
20  AA(I,J) = 0.0
10  CONTINUE
C
C      IF (NP.EQ.0) GO TO 35
C
C      FORM UPPER LEFT PARTITION OF MATRIX AA IF NP = NC
C
C      DO 30 I=1,NP
C      DO 40 J=1,NP
40  AA(I,J) = AP(I,J)
30  CONTINUE
C
C      FORM LOWER LEFT PARTITION OF MATRIX AA IF NP = NC
C
C      DO 50 I=1,NJ

```

```

      DO 60 J=1,NC
60    AA(I+NP+ND,J) = B(I,J)
50    CONTINUE
C
C      FORM CENTER PARTITION OF MATRIX AA IF NP = NC,
C      OR THE UPPER RIGHT PARTITION OF MATRIX AA IF NP = 0
C
35    DO 70 I=1,ND
      DO 80 J=1,ND
80    AA(I+NP,J+NP) = AG(I,J)
70    CONTINUE
C
C      FORM LOWER RIGHT PARTITION OF MATRIX AA
C
      DO 90 I=1,NU
      DO 100 J=1,NU
100   AA(I+NP+ND,J+NP+ND) = AU(I,J)
90    CONTINUE
C
C      FORM LOWER CENTER PARTITION OF MATRIX AA IF NP = NC
C      OR THE LOWER LEFT PARTITION OF MATRIX AA IF NP = 0
C
      DO 110 I=1,NU
      DO 120 J=1,ND
120   AA(I+NP+ND,J+NP) = D(I,J)
110   CONTINUE
C
      RETURN
      END

```

```

C: ::::::::::::::::::::::::::::::::::::::::::::::::::::
C: SUBROUTINE FORMBB
C: ::::::::::::::::::::::::::::::::::::::::::::::::::::::
C:
C: THIS SUBROUTINE FORMS THE AUGMENTED MATRIX -
C:
C: BB = [ 0 ]
C:      [ B ]
C:
C: - FROM THE MATRIX B AND THE ZERO PARTITION
C: HAS ND ROWS
C: -----
C:
C: CALL STATEMENT ARGUMENTS -
C:
C: B : NU X NC MATRIX OF ROW DIMENSION NW
C: BB : NDU X NC MATRIX OF ROW DIMENSION NWY
C: NX : COLUMN DIMENSION OF MATRICES B AND BB
C: -----
C:
C: SUBROUTINE FORMBB(B,BB,NW,NX,NWY)
C: DIMENSION B(NW,NX), BB(NWY,NX)
C:
C: COMMON /DIM/ NU, NC, ND, NM, NP
C:
C: NDU = NU + ND
C:
C: INITIALIZE MATRIX BB TO ZERO
C:
C: DO 10 I=1,NDU
C: DO 20 J=1,NC
20 BB(I,J) = 0.0
10 CONTINUE
C:
C: . FORM LOWER PARTITION OF MATRIX BB
C:
C: DO 30 I=1,NU
C: DO 40 J=1,NC
40 BB(I+ND,J) = B(I,J)
30 CONTINUE
C:
C: RETURN
C: END

```

```

C:.....
C      SUBROUTINE FORMCC
C:.....
C
C      THIS SUBROUTINE FORMS THE MATRIX -
C
C          CC = [ E ↑ F ↑ C ]
C
C          - FROM THE MATRICES C, E AND F
C
C-----
C
C      CALL STATEMENT ARGUMENTS -
C
C          C : NM X NU MATRIX OF ROW DIMENSION NZ
C          E : NM X NC MATRIX OF ROW DIMENSION NZ
C          F : NM X ND MATRIX OF ROW DIMENSION NZ
C          CC : NM X NCDU MATRIX OF ROW DIMENSION NWXY
C          NW : COLUMN DIMENSION OF MATRIX C
C          NX : COLUMN DIMENSION OF MATRIX E
C          NY : COLUMN DIMENSION OF MATRIX F
C
C-----
C
C      SUBROUTINE FORMCC(C,E,F,CC,NW,NX,NY,NZ,NWXY)
C      DIMENSION C(NZ,NW), E(NZ,NX), F(NZ,NY), CC(NZ,NWXY)
C
C      COMMON /DIM/ NU, NC, ND, NM, NP
C
C      NPDU = NU + ND + NP
C
C      INITIALIZE MATRIX CC TO ZERO
C
C      DO 10 I=1,NM
C      DO 20 J=1,NPDU
C      CC(I,J) = 0.0
C      CONTINUE
C
C      IF (NP.EQ.0) GO TO 25
C
C      FORM LEFT PARTITION OF MATRIX CC IF NP = NC
C
C      DO 30 I=1,NM
C      DO 40 J=1,NC
C      CC(I,J) = E(I,J)
C      CONTINUE
C
C      FORM CENTER PARTITION OF MATRIX CC IF NP = ND
C      OR FORM LEFT PARTITION OF MATRIX CC IF NP = 0
C
C      DO 50 I=1,NM
C      DO 60 J=1,ND
C      CC(I,J+NP) = F(I,J)
C      CONTINUE
C
C      FORM RIGHT PARTITION OF MATRIX CC
C
C      DO 70 I=1,NM
C      DO 80 J=1,NU
C      CC(I,J+NP+ND) = C(I,J)
C
C      80

```


70
C CONTINUE
 RETURN
 END

```

C::::::::::::::::::::::::::::::::::::::::::::::::::
C      SUBROUTINE FORMGA
C::::::::::::::::::::::::::::::::::::::::::::::::::
C
C      THIS SUBROUTINE FORMS THE MATRICES -
C
C      
$$GGA = \begin{bmatrix} 0 \\ GG \\ 0 \end{bmatrix}; \quad GPA = \begin{bmatrix} GP \\ 0 \\ 0 \end{bmatrix}$$

C
C      - FROM THE MATRICES GG AND GP
C      IF NP = 0, WHERE THE LOWER
C      ZERO PARTITIONS HAVE NU ROWS
C      AND THE OTHER ZERO PARTITIONS
C      ARE COMPATABLE WITH THE
C      CORRESPONDING POPULATED PARTITIONS
C
C      AND, THE MATRIX -
C
C      
$$GGA = \begin{bmatrix} GG \\ 0 \end{bmatrix}$$

C
C      - IF NP = NC, WHERE THE LOWER
C      ZERO PARTITION HAS NU ROWS
C
C-----
C
C      CALL STATEMENT ARGUMENTS -
C
C      GG : ND X 1 MATRIX OF ROW DIMENSION NY
C      GP : NC X NC MATRIX OF ROW DIMENSION NX
C      GGA : NPDU X 1 MATRIX OF ROW DIMENSION NWXY
C             (IF NP = 0; NPDU = ND + NU
C             IF NP = NC; NPDU = NP + ND + NU)
C      GPA : NPDU X NU MATRIX OF ROW DIMENSION NWXY
C-----
C
C      SUBROUTINE FORMGA(GG,GP,NWXY,NX,NY,GGA,GPA)
C      DIMENSION GG(NY,1), GP(NX,NX), GGA(NWXY,1), GPA(NWXY,NX)
C
C      COMMON/DIM/ NU, NC, ND, NM, NP
C
C      NPDU = NP + ND + NU
C
C      INITIALIZE MATRICES GGA AND GPA TO ZERO
C
C      DO 1 I=1,NPDU
C      GGA(I,1) = 0.0
C      DO 2 J=1,NC
C      GPA(I,J) = 0.0
C      CONTINUE
C
C      FORM UPPER PARTITION OF MATRIX GGA IF NP = 0
C      OF FORM CENTER PARTITION OF MATRIX GGA IF NP = NC
C
C      DO 3 K=1,ND
C      GGA(K+NP) = GG(K)
C
C      IF (NP.EQ.0) RETURN

```

```
C      FORM UPPER PARTITION OF MATRIX GPA
C
C      DO 4 L=1,NC
C      DO 5 M=1,NC
5      GPA(L,M) = GP(L,M)
4      CONTINUE
C
      RETURN
      END
```

```

C:.....:
C      SUBROUTINE FORMNZ
C:.....:
C
C      THIS SUBROUTINE DETERMINES THE ROW OF ELEMENTS
C      OF THE MATRICES C, E AND F WHICH CORRESPOND
C      TO TERMS OF AN OUTPUT EQUATION WHICH DESCRIBES
C      AN OUTPUT VARIABLE WHICH IS PROPORTIONAL TO
C      THE FIRST DERIVATIVE OF THE STATES, WHERE-
C
C      
$$Y = CX + EU + FW.$$

C
C      THE ROW WHICH CORRESPONDS TO THE THIS RESPONSE
C      IS ASSUMED TO BE THE LAST ROW OF THE MATRICES.
C
C      THE OPERATION OF DETERMINING THE X-DOT
C      PROPORTIONAL ELEMENTS CONSISTS
C      OF EXTRACTING CERTAIN ELEMENTS OF THE MATRICES A,
C      B AND D WHICH APPEAR IN THE OUTPUT EQUATION.
C
C      IN THE SPECIFIC PROBLEM DONE IN THIS STUDY,
C      THE X-DOT PROPORTIONAL OUTPUT IS PLUNGE ACCELERATION.
C      THE ACTUAL NZ EQUATION CAN BE FOUND IN THE TEXT
C      DESCRIBING THIS SUBROUTINE.
C-----
C      CALL STATEMENT ARGUMENTS -
C
C      A : NU X NU MATRIX OF ROW DIMENSION NW
C      B : NU X NC MATRIX OF ROW DIMENSION NW
C      C : NM X NU MATRIX OF ROW DIMENSION NZ
C      D : NU X ND MATRIX OF ROW DIMENSION NW
C      E : NM X NC MATRIX OF ROW DIMENSION NZ
C      F : NM X ND MATRIX OF ROW DIMENSION NZ
C      NX : COLUMN DIMENSION OF MATRICES B AND E
C      NY : COLUMN DIMENSION OF MATRICES D AND F
C      X : 1 X NU TRANSFORMATION ROW VECTOR OF
C          COLUMN DIMENSION NW
C      CNM: 1 X NM UTILITY ROW VECTOR OF NZ ELEMENTS
C          FOR THE MATRIX C OF COLUMN DIMENSION NW
C      ENM: 1 X NC UTILITY ROW VECTOR OF NZ ELEMENTS
C          FOR THE MATRIX E OF COLUMN DIMENSION NX
C      FNM: 1 X ND UTILITY ROW VECTOR OF NZ ELEMENTS
C          FOR THE MATRIX F OF COLUMN DIMENSION NY
C-----
C      SUBROUTINE FORMNZ(A,B,C,D,E,F,NW,NX,NY,NZ,X,CNM,ENM,FNM)
C      DIMENSION A(NW,NW), B(NW,NX), C(NZ,NW)
C      DIMENSION D(NW,NY), E(NZ,NX), F(NZ,NY)
C      DIMENSION X(1,NW), CNM(1,NW), ENM(1,NX), FNM(1,NY)
C
C      COMMON /DIM/ NU, NC, ND, NM, NP
C-----
C      SUBROUTINE MULT ( A, B, AB, L, M, N, NA, NB, NAB )
C
C      COMPUTES THE MATRIX PRODUCT:  $AB = A * B$ 
C      A : L X M MATRIX WITH ROW DIMENSION NA

```

```

C::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
C      SUBROUTINE MODAL
C::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
C
C      THIS SUBROUTINE DETERMINES THE EIGENVECTORS,
C      MODAL MATRIX AND INVERSE MODAL MATRIX OF A
C      GENERAL MATRIX.
C
C-----
C
C      CALL STATEMENT ARGUMENTS -
C
C      AA   : NPDU X NPDU MATRIX OR ROW DIMENSION NWCY
C      EIG  : NPDU VECTOR OF EIGENVALUES OF MATRIX AA OF
C             DIMENSION NWCY
C      EE   : NPDU X NPDU MATRIX OF EIGENVECTORS OF AA
C             OF ROW DIMENSION NWCY
C      EI   : NPDU X NPDU MATRIX INVERSE OF EE OF ROW
C             DIMENSION NWCY
C
C-----
C
C      SUBROUTINE MODAL(AA,EIG,EE,EI,NWCY)
C      DIMENSION AA(NWCY,NWCY), WK(1000)
C      COMPLEX EIG(NWCY), EE(NWCY,NWCY), EI(NWCY,NWCY)
C
C      COMMON /DIM/ NU, NC, ND, NM, NP
C
C      NPDU = NU + NP + ND
C
C-----
C
C      SUBROUTINE GEIGEN ( NA, AA, N, JOB, WK, KPR, FROM,
C                        EIG, NE, EE, EI, NAME )
C
C      COMPUTES EIGENVALUES AND, OPTIONALLY, MODAL MATRIX OR
C      NORMALIZED MODAL MATRIX AND INVERSE MODAL MATRIX OF A
C      REAL GENERAL MATRIX
C
C      INPUT ARGUMENTS-
C      AA(N,N): REAL GENERAL MATRIX WITH ROW
C                DIMENSION NA
C      N : ORDER OF AA
C      JOB : OPTION CONTROL
C            = 0 : EIGENVALUES ONLY
C            = 1 : EIGENVALUES AND MODAL MATRIX
C            = 2 : EIGENVALUES, MODAL MATRIX AND
C                  INVERSE MODAL MATRIX
C            = 3 : SAME AS 1 WITH NORMALIZED
C                  MODAL MATRIX
C            = 4 : SAME AS 2 WITH NORMALIZED
C                  MODAL MATRIX
C      WK : REAL WORK VECTOR OF LENGTH GREATER
C            THAN 2*N*N + 3*N
C      KPR : PRINT CONTROL
C            = 0 : PRINT NOTHING
C            = 1 : PRINT EIGENVALUES
C            = 2 : PRINT EVERYTHING
C      FROM : 10-CHARACTER NAME OF CALLING PROGRAM

```

OUTPUT ARGUMENTS-

EIG(N) : COMPLEX VECTOR OF EIGENVALUES OF AA
 EE(N,N) : MODAL MATRIX WITH ROW DIMENSION NE
 EI(N,N) : EE INVERSE WITH ROW DIMENSION NE.

CALL GEIGEN(NWXY,AA,NPDV,4,WK,1,≠MODAL≠,EIG,NWXY,EE,EI,≠A-AUG≠)

RETURN
END

```

C::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
C      SUBROUTINE PHAG
C::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
C
C      THIS ROUTINE CALCULATES AND PRINTS COMPLEX MATRICES
C      IN MAGNITUDE AND PHASE FORM.
C
C-----
C
C      CALL STATEMENT ARGUMENTS -
C
C      ARRAY   : N X M COMPLEX MATRIX OF ROW DIMENSION NROW
C      ITITLE  : TWO WORD LENGTH LITERAL ARRAY CONTAINING THE
C                NAME OF ARRAY IN THE MAIN PROGRAM
C      AMASE   : NRA X 2 ARRAY CONTAINING THE MAGNITUDE AND
C                PHASE FORM OF THE ELEMENTS OF THE COLUMNS OF ARRAY
C      MATOUT  : N X M COMPLEX MATRIX OF ROW DIMENSION NRA
C                CONTAINS ARRAY TRANSFORMED INTO MAGNITUDE AND PHASE
C                FORM
C
C-----
C
C      SUBROUTINE PHAG (ARRAY,NROW,N,M,ITITLE,AMASE,MATOUT,NRA)
C
C      COMPLEX ARRAY(NROW,M), MATOUT(NRA,M)
C      DIMENSION AMASE(NRA,2), ITITLE(2)
C
C      NROW : ROW DIMENSION OF THE INCOMING MATRIX
C      NRA  : ROW DIMENSION OF THE OUTPUT MATRIX
C
C      PRINT HEADER FOR OUTPUT MATRIX
C      BOTH WORDS OF ITITLE CAN BE SET IN A DATA STATEMENT OR
C      INDIVIDUALLY USING DIRECT ASSIGNMENT.
C
C      I.E. ITITLE(1)=10HCONTROLLAB
C           ITITLE(2)=10HILITY=====
C
C      NO ERRORS WILL BE FLAGGED IF ITITLE IS PASSED AS A SINGLE VARIABLE;
C      HOWEVER, THE REMAINING WORD WILL BE PRINTED AS JUNK CHARACTERS IN
C      THE HEADER.
C
C      WRITE(6,100)
C      WRITE(6,110) ITITLE,N,M
C      WRITE(6,120)
C
C      PHAG LOOPS THROUGH ARRAY COLUMN BY COLUMN CONVERTING
C      EACH ELEMENT INTO MAGNITUDE AND PHASE FORM.
C
C      DO 10 JP=1,M
C
C      REINITIALIZE AMASE
C
C      DO 1 KP=1,N
C      AMASE(KP,1)=0.0
C      AMASE(KP,2)=0.0
C      1 CONTINUE
C      DO 5 IP=1,M
C
C      SEPARATE REAL AND IMAGINARY PARTS OF COMPLEX NUMBERS
C      REAL AND AIMAG ARE ANSI STANDARD FORTRAN FUNCTIONS

```

```

C      TERM1=REAL (ARRAY(IP,JP))
      TERM2=AIMAG (ARRAY(IP,JP))
      AMASE(IP,1)=SQRT (TERM1**2+TERM2**2)
      IF (ABS (TERM1).LT.1.0E-15) TERM1=1.0E-15
C
C      ATAN2 RETURNS ARGUMENT IN RADIANS ( -PI < THETA < PI )
C
C      AMASE(IP,2)=ATAN2 (TERM2,TERM1)
C
C      CONVERSION TO DEGREES
C
C      AMASE(IP,2)=57.29578*AMASE(IP,2)
C
C      LOAD INTO OUTPUT MATRIX
C
C      CMLPX IS ANSI STANDARD REAL TO COMPLEX CONVERSION
C
C      MATOUT(IP,JP)=CMLPX (AMASE(IP,1), AMASE(IP,2))
C
C      5 CONTINUE
      10 CONTINUE
C
C      USE COMPLEX MATRIX OUTPUT ROUTINE TO PRINT MATOUT
C      HEADER PRINTING SUPRESSED (LPRINT= -1)
C
C      CALL CMPRNT (NRA,MATOUT,N,M,6,6,OUTPUT,-1)
C
C      100 FORMAT (////////,10X,50(=))
      110 FORMAT (10X,2A10,= MATRIX (=,I2,= BY =,I2,=) =,/
      →      15X,=OUTPUT FORM: ( MAGNITUDE , P hASE(DEG.) )=)
      120 FORMAT (10X,50(=))
      RETURN
      END

```



```

C::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
C      SUBROUTINE RESID
C::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
C
C      THIS SUBROUTINE DETERMINES THE OUTER PRODUCT
C      OF THE MATRIX OBS AND A COLUMN OF THE MATRIX CON.
C      THIS MATRIX RESMAT . PRESENTS AN IMPULSE RESIDUE
C      MATRIX.
C
C      THE ELEMENTS OF THE RESMAT MATRIX ARE WRITTEN TO A TAPE
C      SO THAT POST EXECUTION ANALYSIS CAN BE PERFORMED. SOME
C      EXAMPLES OF THIS MIGHT BE NORMALIZATION OR REORDERING
C      OF THE RESIDUES ASSOCIATED WITH PARTICULAR MODES.
C-----
C      CALL STATEMENT ARGUMENTS -
C
C      CON      : NPDU X NC MATRIX OF ROW DIMENSION NUXY
C      OBS      : NM X NPDU MATRIX OF ROW DIMENSION NZ
C      NX       : COLUMN DIMENSION OF MATRIX CON
C      RESMAT   : MATRIX FORMED FROM OUTER PRODUCT OF
C                OBS AND A COLUMN OF CON
C      I        : COLUMN OF CON USED IN DETERMINING RESMAT
C-----
C      SUBROUTINE RESID(CON,OBS,NZ,NX,NUXY,RESMAT,I)
C      COMPLEX CON(NUXY,NX), OBS(NZ,NUXY), RESMAT(NUXY,NZ)
C
C      COMMON /DIM/ NU, NC, ND, NM, NP
C
C      NPDU = NP + ND + NU
C
C      DO 10 J=1,NM
C      DO 20 K=1,NPDU
C      RESMAT(K,J) = OBS(J,K) * CON(K,I)
20  WRITE(1,100) RESMAT(K,J)
100  FORMAT(2F10.5)
10  CONTINUE
C      RETURN
C      END

```

```

C::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
C      SUBROUTINE SCALE
C::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
C
C      THIS SUBROUTINE SCALES THE MATRICES A, B, C AND D WITH
C      A DIAGONAL MATRIX T. THIS PROCEDURE IS ANALOGOUS TO
C      A CHANGE OF VARIABLE TRANSFORMATION.
C
C      X-DOT = AX + BU + DW
C      Y = CX + EU + FW
C
C      APPLY TRANSFORMATION      X = TZ
C
C      Z-DOT = (TINV*A*T)Z + (TINV*B)U + (TINV*D)W
C      Y = (C*T)X + EU + FW
C
C-----
C
C      SUBROUTINE SCALE (A,B,C,D,NW,NX,NY,NZ,T,TINV,AS,BS,CS,DS)
C      DIMENSION A(NW,NW), B(NW,NX), C(NZ,NW), D(NW,NY)
C      DIMENSION AS(NW,NW), BS(NW,NX), CS(NZ,NW), DS(NW,NY)
C      DIMENSION T(NW,NW), TINV(NW,NW), WRK(500)
C
C      COMMON /DIM/ NU, NC, ND, NM, NP
C
C-----
C
C      SUBROUTINE RINV ( TT, TI, WK, NR, N )
C
C      COMPUTES THE INVERSE OF A REAL MATRIX
C
C      INPUT ARGUMENTS-
C          TT(N,N) : REAL MATRIX WITH ROW DIMENSION NR
C          WK : REAL WORK VECTOR WITH LENGTH
C                GREATER THAN N*N+2*N
C          NR : ROW DIMENSION
C
C      OUTPUT ARGUMENTS-
C          TI(N,N) : INVERSE OF TT WITH ROW DIMENSION NR
C
C-----
C
C      FORM INVERSE OF SCALING MATRIX T
C      CALL RINV(T,TINV,WRK,NW,NU)
C
C-----
C
C      SUBROUTINE MP3 ( NA, AR, A, NB, BR, B, NC, CR, CC, C, NP, P )
C
C      COMPUTE THE MATRIX PRODUCT: P = A*B*C
C
C      A : AR X BR REAL MATRIX WITH ROW DIMENSION NA
C      B : BR X CR REAL MATRIX WITH ROW DIMENSION NB
C      C : CR X CC REAL MATRIX WITH ROW DIMENSION NC
C      P : AR X CC REAL MATRIX WITH ROW DIMENSION NP
C
C-----
C

```

```

C
C      FORM SCALED DYNAMIC MATRIX AS
C
C      CALL MP3(NW,NU,T,NW,NU,A,NW,NU,NU,TINU,NW,AS)
C-----
C
C      SUBROUTINE MEQ ( AIN, AOUT, NR, NC, NRI, NRO )
C
C      STORE MATRIX AIN(NR,NC) IN THE MATRIX AOUT(NR,NC)
C      WHERE AIN AND AOUT HAVE ROW DIMENSIONS NRI AND NRO
C-----
C
C      EQUATE SCALED DYNAMIC MATRIX AS TO DYNAMIC
C      MATRIX A FOR RETURN TO MAIN PROGRAM
C
C      CALL MEQ(AS,A,NU,NU,NW,NW)
C-----
C
C      SUBROUTINE MULT ( A, B, AB, L, M, N, NA, NB, NAB )
C
C      COMPUTE MATRIX PRODUCT:  $AB = A \cdot B$ 
C
C      A : L X M MATRIX WITH ROW DIMENSION NA
C      B : M X N MATRIX WITH ROW DIMENSION NB
C      AB : L X N MATRIX WITH ROW DIMENSION NAB
C      A, B, AB REAL MATRICES
C-----
C
C      FORM SCALED CONTROL MATRIX BS AND EQUATE IT TO THE
C      CONTROL MATRIX B FOR RETURN TO MAIN PROGRAM
C
C      CALL MULT(T,B,BS,NU,NU,NC,NW,NW,NW)
C      CALL MEQ(BS,B,NU,NC,NW,NW)
C
C      FORM SCALED DISTURBANCE MATRIX DS AND EQUATE IT TO
C      THE DISTURBANCE MATRIX D FOR RETURN TO MAIN PROGRAM
C
C      CALL MULT(T,D,DS,NU,NU,ND,NW,NW,NW)
C      CALL MEQ(DS,D,NU,ND,NW,NW)
C
C      FORM SCALED OUTPUT MATRIX CS AND EQUATE IT TO THE
C      OUTPUT MATRIX C FOR RETURN TO MAIN PROGRAM
C
C      CALL MULT(C,TINU,CS,NM,NU,NU,NZ,NW,NZ)
C      CALL MEQ(CS,C,NM,NU,NZ,NZ)
C
C      RETURN
C      END

```

```

C::::::::::::::::::::::::::::::::::::::::::::::::::
C      SUBROUTINE STEP
C::::::::::::::::::::::::::::::::::::::::::::::::::
C
C      THIS SUBROUTINE DETERMINES THE MATRIX OF
C      STEP RESIDUES FOR A GIVEN IMPULSE RESIDUE
C      MATRIX AND A SPECIFIED SET OF EIGEN-
C      VALUES.
C
C      THIS IS DONE BY FORMING A DIAGONAL MATRIX
C      OF THE EIGENVALUES AND POST-MULTIPLYING ITS
C      INVERSE BY THE IMPULSE RESIDUE MATRIX.
C
C-----
C
C      CALL STATEMENT ARGUEMENTS -
C
C      IMP      : NPDU X NM MATRIX OF ROW
C                 DIMENSION NMAXY (IMPULSE RESIDUES)
C      EIG      : NPDU VECTOR OF DIMENSION NMAXY
C                 (VECTOR OF E-VALUES)
C      STP      : NPDU X NM MATRIX OF ROW
C                 DIMENSION NMAXY (STEP RESIDUES)
C      EIGMAT   : NPDU X NPDU DIAGONAL MATRIX
C                 OF ROW DIMENSION NMAXY
C                 (E-VALUES ON DIAGONAL)
C      EINU     : NPDU X NPDU DIAGONAL MATRIX
C                 OF ROW DIMENSION NMAXY
C                 (INVERSE OF EIGMAT)
C
C-----
C
C      SUBROUTINE STEP (IMP,EIG,NMAXY,NZ,STP,EIGMAT,EINU)
C
C      COMPLEX (IMP(NMAXY,NZ), EIG(NMAXY), STP(NMAXY,NZ)
C      COMPLEX EIGMAT(NMAXY,NMAXY), EINU(NMAXY,NMAXY)
C      REAL WK(1000)
C
C      COMMON /DIM/ NU, NC, ND, NM, NP
C
C      NPDU = NP + ND + NU
C
C      INITIALIZE MATRIX EIGMAT TO ZERO
C
C      DO 5 J=1,NPDU
C      DO 6 K=1,NPDU
C      EIGMAT(J,K) = 0.0
C      CONTINUE
C
C      FORM DIAGONAL MATRIX OF E-VALUES
C
C      DO 10 I=1,NPDU
C      EIGMAT(I,I) = EIG(I)
C
C-----
C
C      SUBROUTINE CINU ( TT, TI, WK, NR, N )
C
C      COMPUTE THE INVERSE OF A COMPLEX MATRIX
C
C      INPUT ARGUMENTS-

```

```

C      TT(N,N) : COMPLEX MATRIX WITH ROW DIMENSION NR
C      WK : REAL WORK VECTOR WITH LENGTH
C            GREATER THAN  $N*N*2 + 3*N$ 
C      NR : ROW DIMENSION
C      N : ORDER OF TT AND TI
C
C      OUTPUT ARGUMENTS-
C      TI(N,N) : COMPLEX INVERSE OF TT WITH
C            ROW DIMENSION NR
C-----
C      INVERT DIAGONAL MATRIX OF E-VALUES
C      CALL CINU(EIGMAT,EINU,WK,NWXY,NPDU)
C-----
C      SUBROUTINE MULTCC ( A, B, AB, L, M, N, NA, NB, NAB )
C      COMPUTE MATRIX PRODUCT:  $AB = A*B$ 
C
C      A : L X M COMPLEX MATRIX WITH ROW DIMENSION NA
C      B : M X N COMPLEX MATRIX WITH ROW DIMENSION NB
C      AB : L X N COMPLEX MATRIX WITH ROW DIMENSION NAB
C-----
C      FORM STEP RESIDUE MATRIX
C      CALL MULTCC(EINU,IMP,STP,NPDU,NPDU,NM,NWXY,NWXY,NWXY)
C
C      OUTPUT STEP RESIDUES TO A TAPE
C
C      DO 30 I=1,NM
C      DO 20 J=1,NPDU
20    WRITE(2,200) STP(J,I)
30    CONTINUE
C
200  FORMAT(2F10.5)
C
      RETURN
      END

```

```

C:.....
C      SUBROUTINE WORK
C:.....
C
C      THIS SUBROUTINE FORMS THE COMPLEX MATRICES
C      CON, OBS AND DIST BY MULTIPLYING THE MATICES
C      B, C AND D BY A COMPLEX MATRIX M.
C
C      THIS COMPLEX MATRIX MULTIPLICATION REPRESENTS A
C      TRANSFORMATION THROUGH THE COMPLEX MATRIX M, WHEN
C      THE MATRICES B, C AND D ARE RELATED THROUGH THE
C      STATE VARIABLE EQUATIONS -
C
C          X-DOT = AX + BU + DW
C          Y = CX
C
C      SO THAT -
C
C          CON = MINU * B
C          OBS = C * M
C          DIST = MINU * D
C
C-----
C      CALL STATEMENT ARGUMENTS -
C
C          B      : NPDU X NC MATRIX OF ROW DIMENSION NUXY
C          C      : NM X NPDU MATRIX OF ROW DIMENSION NZ
C          D      : NPDU X ND MATRIX OF ROW DIMENSION NUXY
C          M      : NPDU X NPDU MARTIX OF ROW DIMENSION NUXY
C          MINU   : INVERSE OF MATRIX M
C          NX     : COLUMN DIMENSION OF MATRIX B
C          NY     : COLUMN DIMENSION OF MATRIX D
C          CON    : NPDU X NC MATRIX OF ROW DIMENSION NUXY
C          OBS    : NM X NPDU MATRIX OF ROW DIMENSION NUXY
C          DIST   : NPDU X ND MATRIX OF ROW DIMENSION NUXY
C
C-----
C      SUBROUTINE WORK(B,C,D,M,MINU,NX,NY,NZ,NUXY,CON,OBS,DIST)
C      DIMENSION B(NUXY,NX),      C(NZ,NUXY),      D(NUXY,1)
C      COMPLEX M(NUXY,NUXY), MINU(NUXY,NUXY)
C      COMPLEX CON(NUXY,NX), OBS(NZ,NUXY), DIST(NUXY,1)
C
C      COMMON /DIM/ NU, NC, ND, NM, NP
C
C      NPDU = NU + NP + ND
C
C-----
C      SUBROUTINE MULTCR ( A, B, AB, L, M, N, NA, NB, NAB )
C
C      COMPUTE MATRIX PRODUCT: AB = A*B
C
C          A : L X M COMPLEX MATRIX WITH ROW DIMENSION NA
C          B : M X N REAL MATRIX WITH ROW DIMENSION NB
C          AB : L X N COMPLEX MATRIX WITH ROW DIMENSION NAB
C
C-----

```

```

C      FORM MATRIX CON
C
C      CALL MULTCR(MINU,B,CON,NPDU,NPDU,NC,NWXY,NWXY,NWXY)
C
C-----
C      SUBROUTINE MULTRC ( A, B, AB, L, M, N, NA, NB, NAB )
C
C      COMPUTE MATRIX PRODUCT: AB = A*B
C
C      A : L X M REAL MATRIX WITH ROW DIMENSION NA
C      B : M X N COMPLEX MATRIX WITH ROW DIMENSION NB
C      AB : L X N COMPLEX MATRIX WITH ROW DIMENSION NAB
C
C-----
C      FORM MATRIX OBS
C
C      CALL MULTRC(C,M,OBS,NM,NPDU,NPDU,NZ,NWXY,NZ)
C
C      FORM MATIX DIST
C
C      CALL MULTCR(MINU,D,DIST,NPDU,NPDU,1,NWXY,NWXY,NWXY)
C
C      RETURN
C      END

```

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16. Abstract As aircraft become larger and lighter due to design requirements for increased payload and improved fuel efficiency, they will also become more flexible. For highly flexible vehicles, the handling qualities may not be accurately predicted by conventional methods. This study applies two analysis methods to a family of flexible aircraft in order to investigate how and when structural (especially dynamic aeroelastic) effects affect the dynamic characteristics of aircraft. The first type of analysis is an open-loop modal analysis technique. This method considers the effect of modal residue magnitudes on determining vehicle handling qualities. The second method is a pilot-in-the-loop analysis procedure that considers several closed-loop system characteristics. Both analyses indicated that dynamic aeroelastic effects caused a degradation in vehicle tracking performance, based on the evaluation of some simulation results.					
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